US 20080216396A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2008/0216396 A1

(43) Pub. Date: Sep. 11, 2008

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(54) FUEL PELLET AND METHOD OF PRODUCING FUEL PELLET

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(21) Appl. No.: **11/682,933**

(22) Filed: **Mar. 7, 2007**

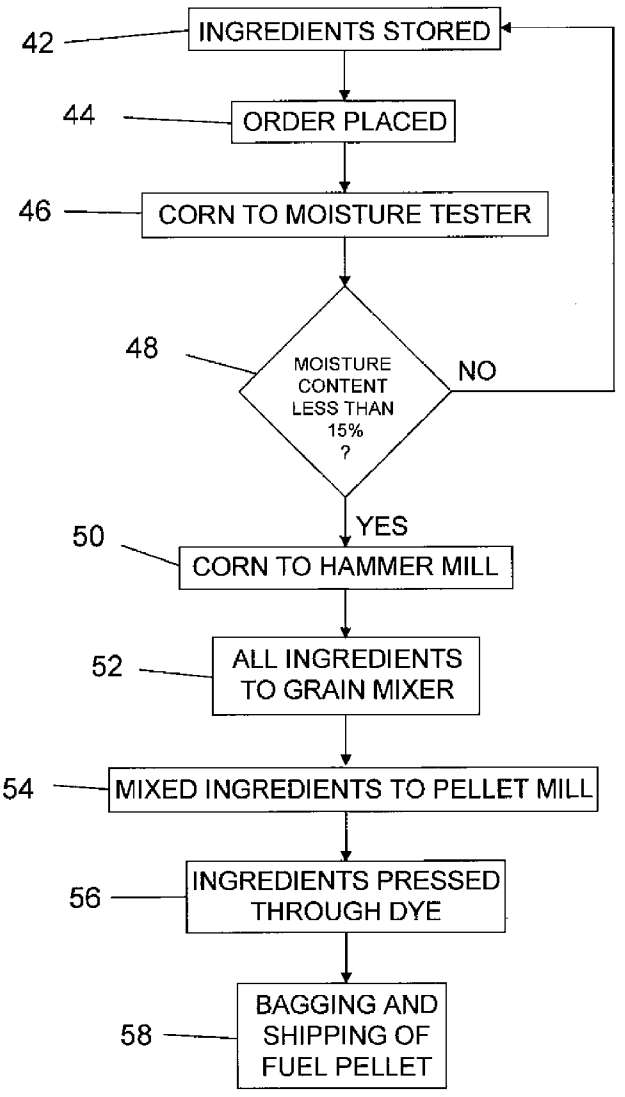
Publication Classification

(51) **Int. Cl.**
C10L 5/00 (2006.01)

(52) **U.S. Cl.** **44/554**; 44/589

(57) **ABSTRACT**

A processed fuel pellet is disclosed, and contains a ground corn product mixed with other commodities that establish the framework for an alternative fuel source burned in pellet stoves and corn stoves. The composition is comprised preferably of about 50% ground shelled corn, about 25% wheat midds as an igniting agent, about 20% soy hulls as a bonding agent and about 5% pulverized limestone as an anti-caking agent. Said ground shelled corn can be varied in alternative embodiments up to a maximum of 75% of the corn component, and other ingredients are adjusted accordingly to provide useful compositions. The pellet produced is a more efficient, hotter burning fuel source that has a low soot output, is economical to produce and environmentally friendly, and a perfect fuel to be used in home heating. A method for producing said fuel pellet is also disclosed which will ensure proper composition and structure.



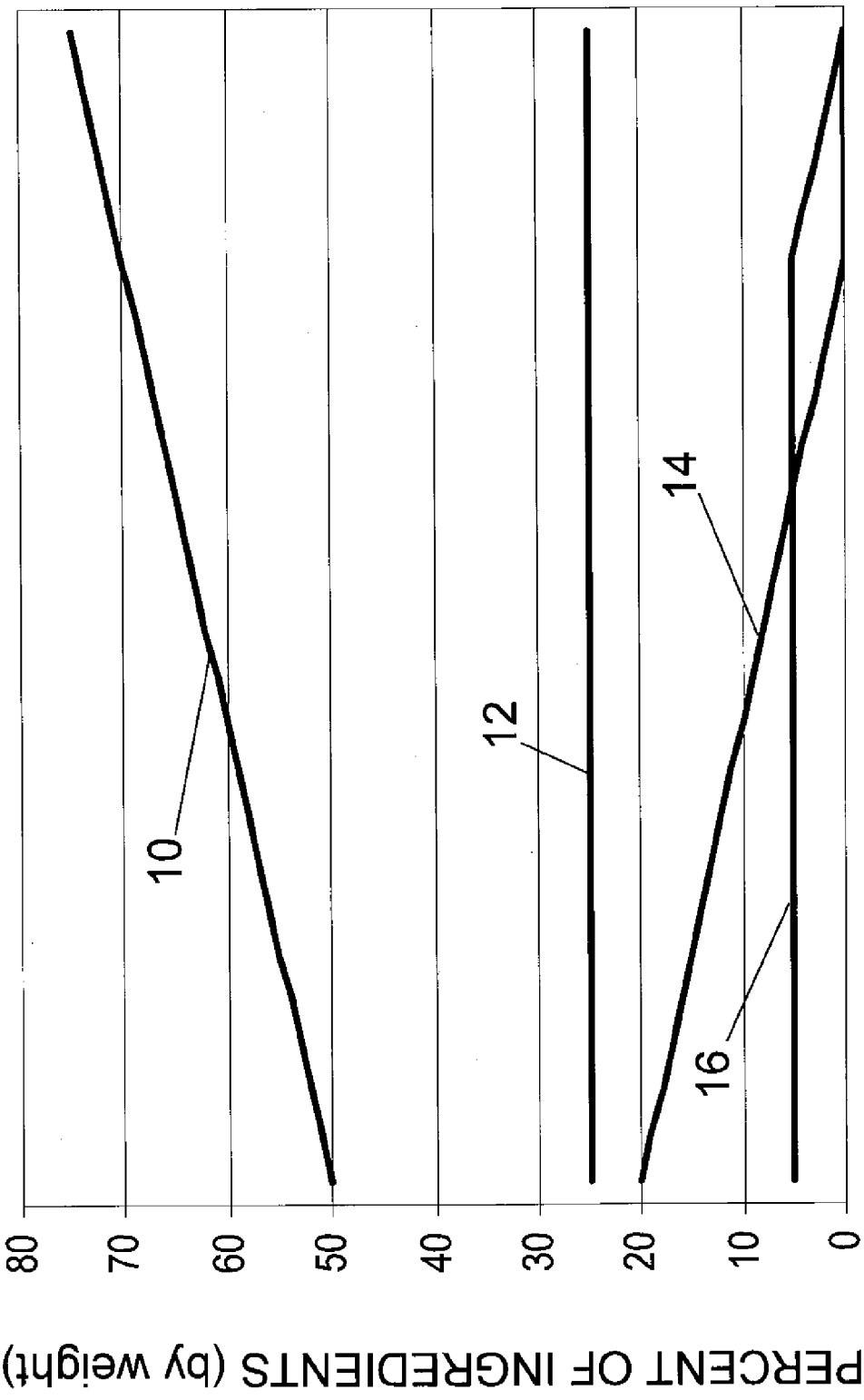

PERCENT OF INGREDIENTS (by weight)
80
70
60
50
40
30
20
10
0
10
12
14
16

FIG. 1

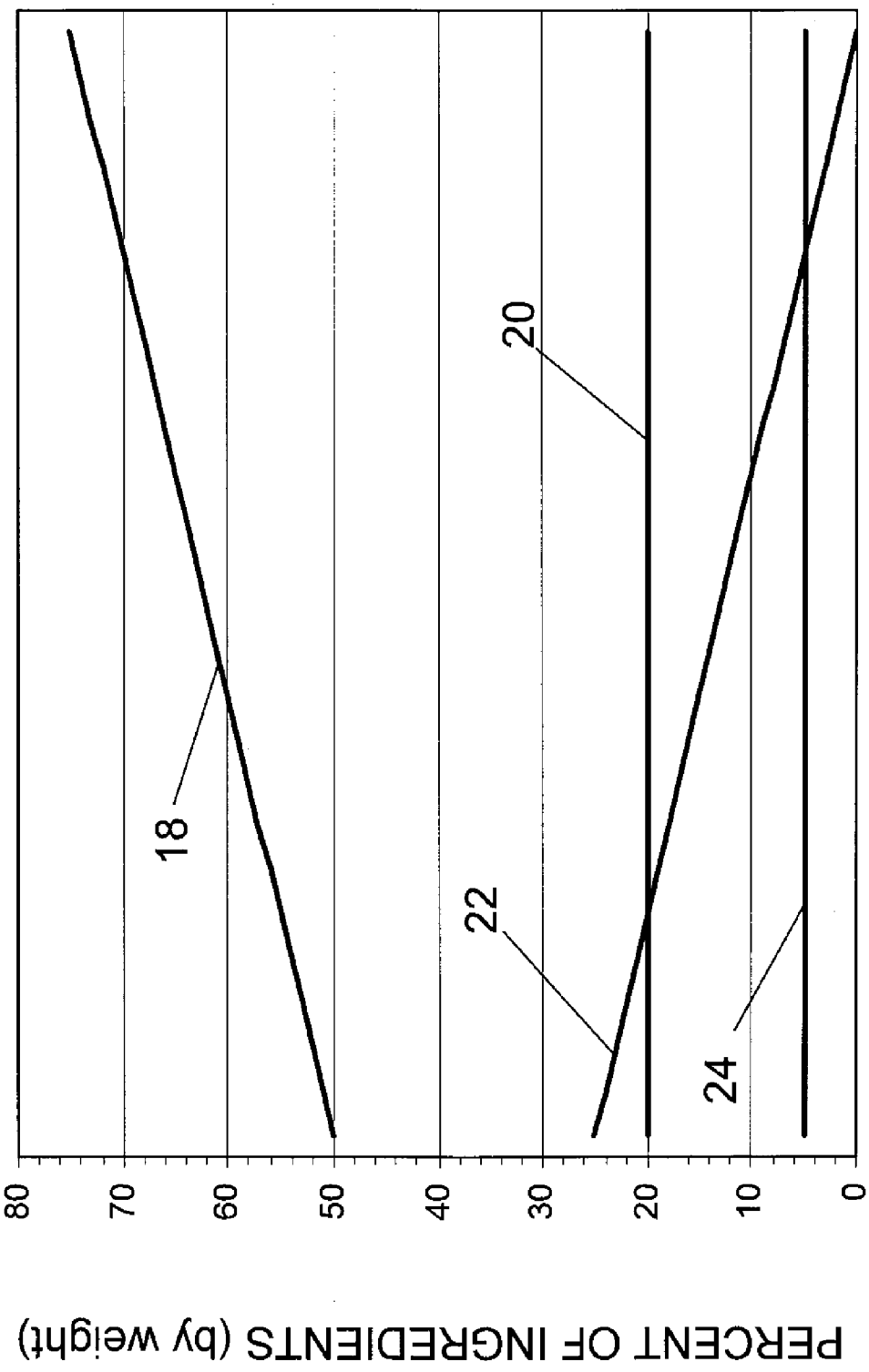

PERCENT OF INGREDIENTS (by weight)
80
70
60
50
40
30
20
10
0
18
20
22
24

FIG. 2

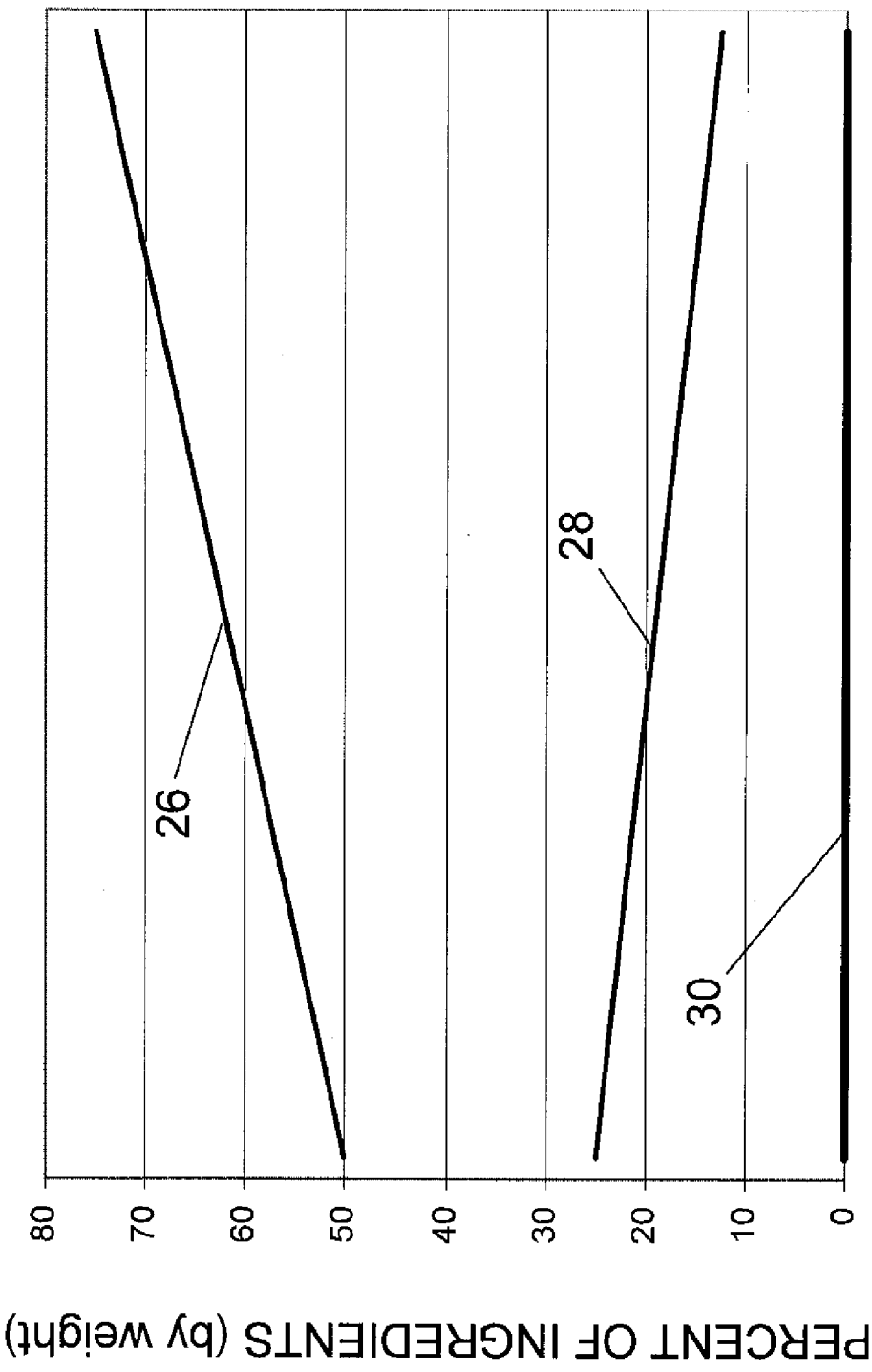

PERCENT OF INGREDIENTS (by weight)
80
70
60
50
40
30
20
10
0
26
28
30

FIG. 3

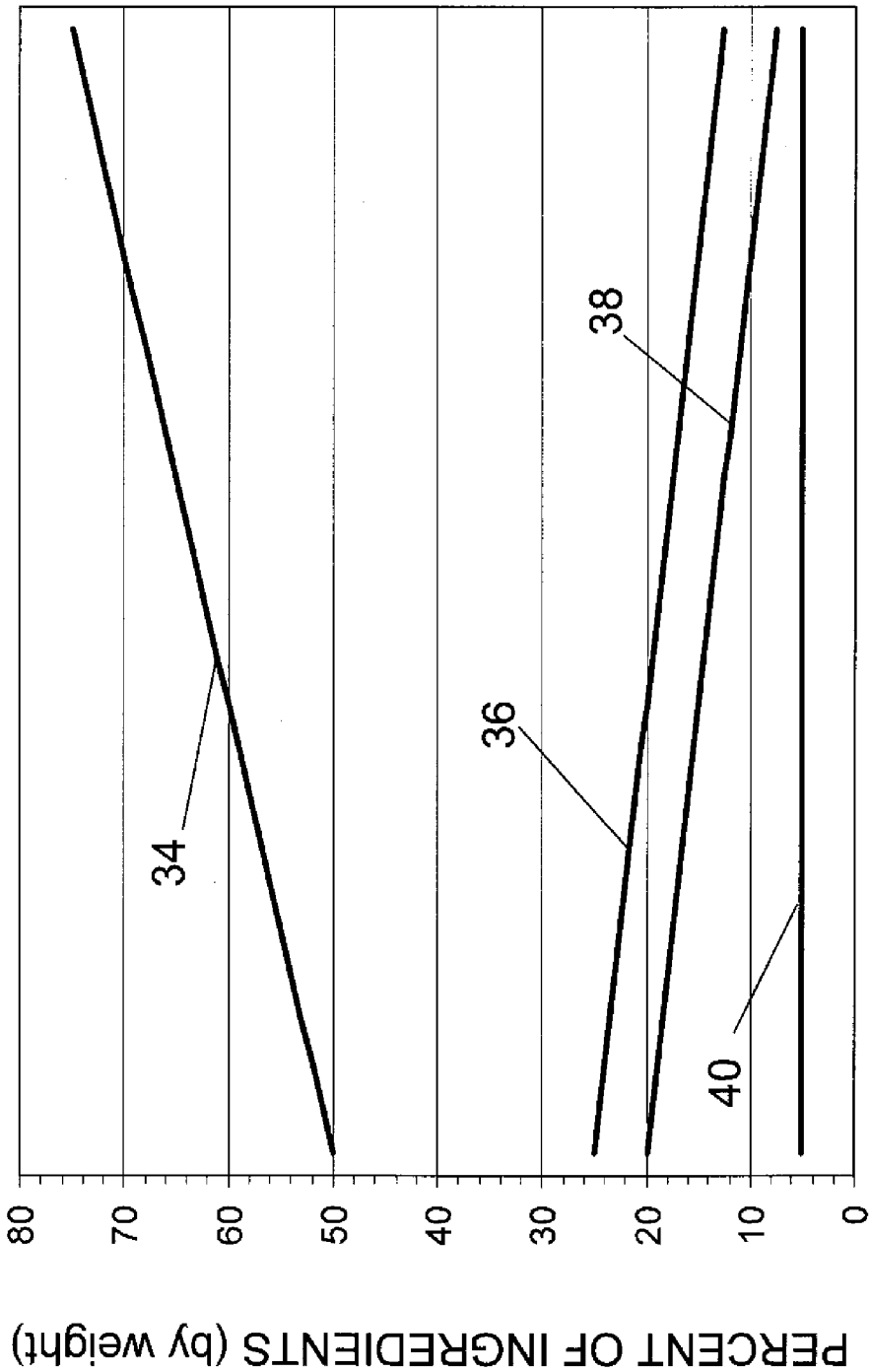

PERCENT OF INGREDIENTS (by weight)
0
10
20
30
40
50
60
70
80
34
36
38
40

FIG. 4

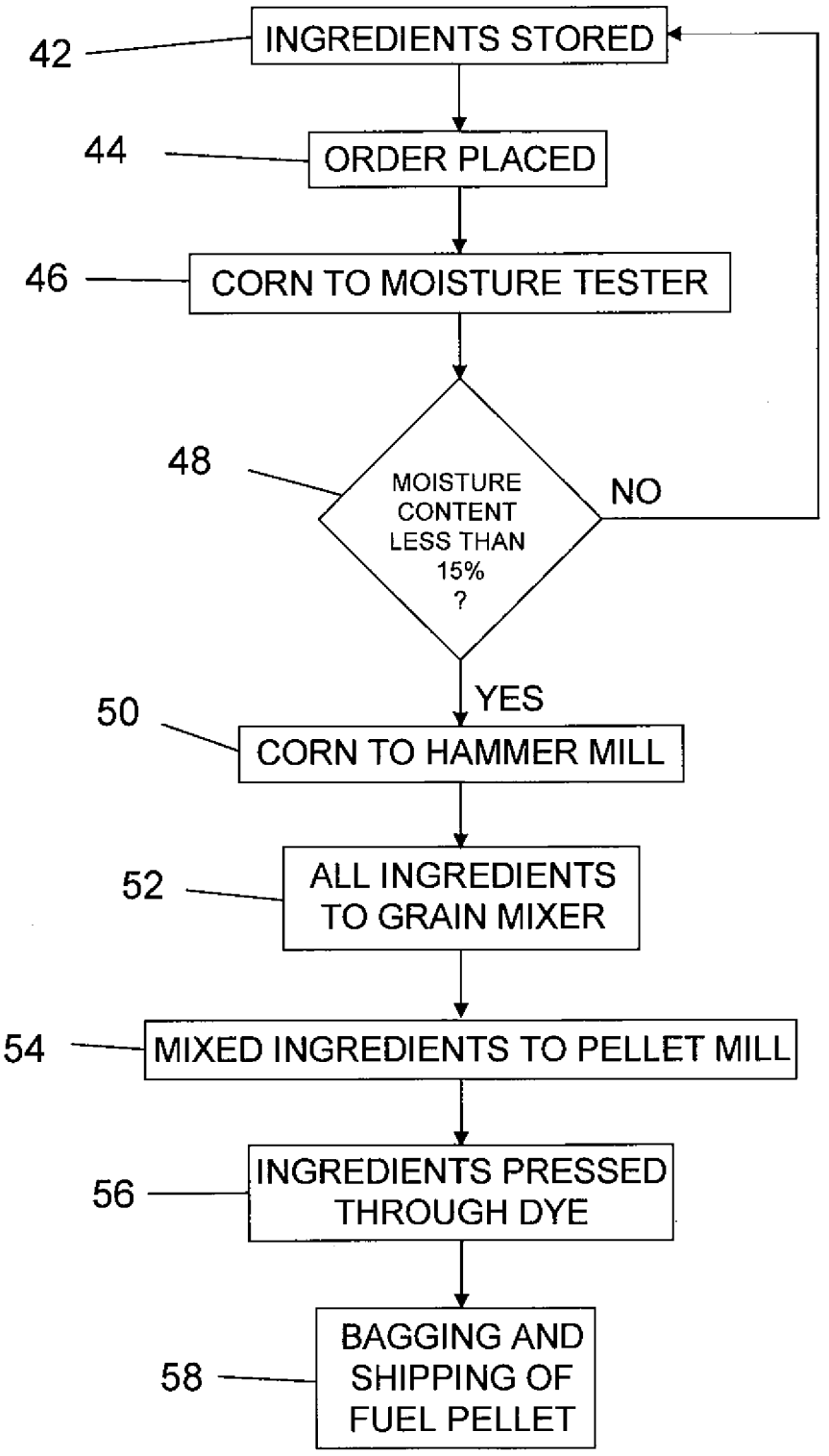

42
INGREDIENTS STORED
44
ORDER PLACED
46
CORN TO MOISTURE TESTER
48
MOISTURE CONTENT LESS THAN 15% ?
NO
YES
50
CORN TO HAMMER MILL
52
ALL INGREDIENTS TO GRAIN MIXER
54
MIXED INGREDIENTS TO PELLET MILL
56
INGREDIENTS PRESSED THROUGH DYE
58
BAGGING AND SHIPPING OF FUEL PELLET

FIG. 5

FUEL PELLET AND METHOD OF PRODUCING FUEL PELLET

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This non-provisional application claims the benefit of U.S. Provisional Application No. 60/810,958, filed Jun. 5, 2006.

FEDERALLY SPONSORED RESEARCH

[0002] Not Applicable.

SEQUENCE LISTING OR PROGRAM

[0003] Not Applicable.

BACKGROUND

[0004] The energy and home heating industry are dominated presently by oil. With fossil fuel prices reaching unprecedented levels world wide, many consumers are turning to alternative fuel sources to heat their homes. Gas, wood and alternative energy are a growing segment of the industry as consumers search for heating methods that are both economical and good for the environment. Manufactured fire logs and wood pellets for fireplaces and stoves are well known and widely used as a convenient heat source. In the recent past, pellets comprised of various cellulosic materials have emerged as an alternative fuel source for home heating. In Europe, where there is a significant push for environmentally safe, affordable fuel alternatives, the wood pellet has enjoyed overwhelming popularity. Despite the fact that the U.S. has been slow to catch on to this trend, indications are that the use of wood pellets is growing. According to the Pellet Fuels Institute, sales in the U.S. of pellet stoves increased by 74 percent from 2004 to 2005. While being a positive indicator for the industry, this increase spurred a nationwide pellet shortage. With much of the nation's wood pellet supply being shipped overseas, producers were unable to meet the demand on home soil. Prices of the pellets more than doubled and despite placing restrictions on the number of bags that could be purchased at one time, many retailers ran through new shipments in less than a day. Unable to get enough fuel to heat their homes, consumers were forced to resort to fossil fuels for the remainder of the winter.

[0005] Moreover, the quality of the pellets has recently been in question because of the addition of sub-grade materials and thermoplastics, which together produce fewer BTUs, more emissions, soot and ash. Most wood pellets are made from compressed sawdust, which is a by-product in the furniture making and other wood processing industries, and a wax or thermoplastic bonding agent. The addition of wax or thermoplastic in the pelleting process serves to bond the mixture together. However, when burned, this bonding agent emits harmful and/or damaging chemicals and soot into the environment.

[0006] Furthermore, new technologies are consuming more of the raw materials used to make the pellets. Even though trees are a renewable, natural resource, their slow maturation rate, combined with the nation's thriving lumber trade, will continue to present challenges to the wood pellet industry. To meet the nation's growing need for clean, affordable, accessible heating sources, the U.S. must vigilantly pursue viable alternatives.

[0007] Information relevant to attempts to address these problems can be found in U.S. Pat. Nos. 3,635,684, 4,236,897, 4,324,561, 4,529,407, 4,702,746, 5,342,418, 5,393,310, 5,980,595, 6,113,662, 6,635,093, 6,793,697, 6,811,759, and International Publication Numbers WO2004/015041 and WO2000/60030. However, each one of these references suffers from one or more of the following disadvantages: (1) product contains a thermoplastic bonding material, causing a less environmentally friendly output as well as increased soot build-up and emissions, (2) product has a lower overall heat output and (3) product is more expensive to produce.

[0008] For the foregoing reasons, there is a need for a more environmental friendly and efficient, cheaper and more readily available alternative fuel product that can ease the United States' dependency upon oil and satisfy the deficiency in the pellet industry.

SUMMARY

[0009] This invention is directed to a fuel pellet that will satisfy the need for a more environmental friendly and efficient, cheaper and more readily available alternative fuel product that can ease the United States' dependency upon oil. The fuel pellet having features of the present invention comprises a mixture with a majority of ground shelled corn, and further comprises a bonding agent, an igniting agent, and an anti-caking agent in certain mixtures. In an optional embodiment of the aforementioned fuel pellet, the corn may be comprised wholly of grade 2 ground shelled corn having a moisture content of not more than about 15% by weight. As a further option, the bonding agent may be comprised solely, or in part, of soy hulls, milo, or any type of distiller grain, among other things. As an alternative option, the anti-caking agent may be comprised solely, or in part, of pulverized limestone, dehydrated phosphorus, or crushed egg shells, among other things. As yet another option, the igniting agent may be comprised solely, or in part, of wheat midds, speltz, milo, or any type of dried distiller grain, among other things.

[0010] It is the object of this invention to: (1) provide an efficient, cost effective, environmentally friendly fuel source with low soot output, in the form of a fuel pellet; (2) provide a fuel pellet containing a major portion of ground, shelled corn; (3) provide a fuel pellet with a high heat output; and (4) promote the production and processing of corn in the United States of America, and further support the farmers who grow and process this crop.

[0011] Furthermore, this invention provides a method for the production of this fuel pellet. This method is novel due to the novel use of ingredients in the aforementioned composition. Generally, the method involves grinding shelled corn into a fine powder, mixing this with the other ingredients and pressing them through a die to produce a novel, clean burning heating source ready for packaging and shipping. All shelled corn must have a moisture content less than 15% to ensure proper bonding of the ingredients, and to prevent caking during the grinding and pressing steps.

DESCRIPTION OF THE DRAWINGS

[0012] The drawings presented hereafter are to be used together with the description and appended claims to explain the inventive aspects of the invention, and representative examples of the embodiments herein. The drawings are not to be construed as limiting the invention to only the illustrated and described embodiments.

[0013] FIG. **1** is a graph showing a percentage range of ingredients in an alternative embodiment of the invention, where the percent of the igniting agent is held constant;

[0014] FIG. **2** is a graph showing a percentage range of ingredients in an alternative embodiment of the invention, where the percent of the bonding agent is held constant;

[0015] FIG. **3** is a graph showing a percentage range of ingredients in an alternative embodiment of the invention, where the percent of the anti-caking agent is zero, and the percentages of the igniting agent and the bonding agent are reduced proportionately as the percentage of corn is increased;

[0016] FIG. **4** is a graph showing a percentage range of ingredients in an alternative embodiment of the invention, where the percent of the anti-caking agent is 5%, and the percentages of the igniting agent and the bonding agent are reduced proportionately as the percentage of corn is increased; and

[0017] FIG. **5** is a block diagram that shows the method by which the invention is produced.

REFERENCE NUMERALS IN DRAWINGS

[0018] **10** percentage of shelled corn

[0019] **12** percentage of igniting agent

[0020] **14** percentage of bonding agent

[0021] **16** percentage of anti-caking agent

[0022] **18** percentage of shelled corn

[0023] **20** percentage of igniting agent

[0024] **22** percentage of bonding agent

[0025] **24** percentage of anti-caking agent

[0026] **26** percentage of shelled corn

[0027] **28** percentage of igniting agent and bonding agent

[0028] **30** percentage of anti-caking agent

[0029] **34** percentage of shelled corn

[0030] **36** percentage of igniting agent

[0031] **38** percentage of bonding agent

[0032] **40** percentage of anti-caking agent

[0033] **42** all ingredients input to storage

[0034] **44** customer places order

[0035] **46** shelled corn is sent to moisture tester

[0036] **48** decision step at moisture tester, is moisture content less than 15%?

[0037] **50** corn to hammer mill

[0038] **52** all ingredients to grain mixture

[0039] **54** mixed ingredients to pellet mill

[0040] **56** ingredients processed at pellet mill and pressed through die

[0041] **58** pellets then ready for bagging and shipping

DESCRIPTION

[0042] The present invention provides both a fuel pellet and a process for its manufacture. The fuel pellet herein provides a novel combination of ingredients to provide a cleaner burning, more environmentally friendly fuel to be used in pellet stoves and/or corn stoves. This combination of ingredients is novel in that it uses ingredients from a list comprised of shelled corn along with other commodity by-products never before integrated to satisfy the overall goals of providing a mixture which is easily produced, with low soot and high temperature output. Ground shelled corn is used as the primary ingredient to produce a high heat output when burned in a corn or pellet stove for home, office or industrial heating. An igniting agent is added to the mix which enables the resulting pellet quickly combust when placed in a pellet or corn stove. A bonding agent is added to bond the material together, along with an anti-caking agent that promotes flowability when the material is pushed through the pellet die during production.

[0043] The reader's attention is directed to all papers and documents which are filed concurrently with this specification and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference. All features disclosed in this specification (including any accompanying claims, abstract or drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The Fuel Pellet

DESCRIPTION—PREFERRED EMBODIMENT

[0044] The preferred embodiment and best mode specifies a particular ratio of amounts of ingredients that will be passed through the method of production as described below. Generally, this invention comprises fine ground shelled corn as the primary heating source, a bonding agent, an anti-caking agent and an igniting agent. Specifically, and in the best mode, the following relative amounts of ingredients should be used: 50% by weight grade 2 fine-ground shelled corn, 20% by weight soy hulls as a bonding agent; 25% by weight wheat midds as an igniting agent, and 5% pulverized limestone as an anti-caking agent. The preferred moisture content of all ingredients must be less than or equal to 15%. This ensures proper bonding of the ingredients and flowability of the mix as it is pressed through the pellet mill die.

DESCRIPTION—ALTERNATIVE EMBODIMENTS

[0045] Although the present invention has been described in considerable detail with reference to a certain preferred version thereof, other versions are possible. For example, Attached FIGS. **1-4** will be used to display the range of desired amounts of ingredients included in alternative embodiments. The percentage of ground shelled corn can be increased from around 50% to around 75%. The remaining amounts of ingredients must be adjusted accordingly, and this is exhibited in FIGS. **1-4**.

[0046] Furthermore, while the preferred anti-caking agent is pulverized limestone, alternatively, pulverized dehydrated phosphorus, or crushed egg shells may be used. Additionally, while the preferred igniting agent is wheat midds, alternatively speltz, milo, barley, oats or wheat may be used. Finally, while the preferred bonding agent is soy hulls, alternatively milo or any type of drier distiller grain may be used.

[0047] FIG. **1** represents an alternative embodiment whereby the percentage by weight of ground shelled corn is increased in a linear fashion from about 50% to about 75% **10**. The percentage by weight of the igniting agent is held constant at 25% **12**, the percentage by weight of the bonding agent is thusly decreased from 20% to 0% **14** in a linear fashion relative to the increase in ground shelled corn, and the percentage by weight of the anti-caking agent is adjusted accordingly **16**. The percentage of ground shelled corn must

not exceed approximately 75% by weight, doing so would cause the fuel pellet to become unstable in its final state and potentially crumble apart.

[0048] FIG. **2** represents an alternative embodiment whereby the percentage by weight of ground shelled corn is increased in a linear fashion from about 50% to about 75% **18** as above. However, this embodiment maintains the percentage the bonding agent at 20% by weight **20**. The percentage of the igniting agent is decreased in a linear fashion from around 25% to 0 **22**. The anti-caking agent will remain constant at around 5% **24**.

[0049] Similarly, FIG. **3** represents an additional alternative embodiment whereby the percentage by weight of ground shelled corn is increased linearly from about 50% to about 75% **26**. In this embodiment, the percentage by weight of both the igniting agent and the bonding agent are decreased proportionately and in a linear fashion from about 25% to about 12.5% **28**. The anti-caking agent is not included in this embodiment **30**.

[0050] FIG. **4** represents an alternative embodiment whereby the percentage by weight of ground shelled corn is increased in a linear fashion from about 50% to about 75% **34**. Alternatively, this embodiment decreases the percentage by weight for the igniting agent in a linear fashion from about 25% to about 12.5% **36**. Furthermore, the percentage by weight of the bonding agent is decreased linearly from about 20% to about 7.5% **38**, with the percentage by weight of the anti-caking agent being held constant at about 5% **40**.

[0051] The previously described versions of the present invention have many advantages, including: high heat output, clean burning and low soot output and environmentally friendly. However, the invention does not require that all advantageous features and all the advantages need to be incorporated into every embodiment of the invention. Furthermore, the present invention has been described in considerable detail with reference to certain preferred versions thereof, other versions are possible. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained herein.

The Method of Production

[0052] FIG. **5** shows the method of producing fuel pellet. All ingredients are initially stored **42**. Wheat midds, a preferred choice as an igniting agent, are a by-product from the milling of wheat flour or durum as used in pasta. Typically pressed into pellets and used as cattle feed, wheat midds require no preparation, other than to ensure a moisture content of less than or equal to 15%. Similarly, soy hulls, the preferred choice as a bonding agent, are a by product of soybean processing. Used primarily as an ingredient in cattle feed, soy hulls require no preparation. Following a customer order **44**, the shelled corn must be tested for moisture quantity immediately prior to being ground **46**. As mentioned previously, the moisture content must not exceed 15% **48**. If the moisture content is found to be greater than 15%, the shelled corn is returned to storage where further drying will occur **42**. If the moisture content is found to be less than 15%, the shelled corn is then shipped to the hammer mill where it is ground to particles that do not exceed 3.1 mm in any dimension **50**. Preferably, the particles will not exceed 1.5 mm in any dimension. These measurements are determined by the screen mesh at the hammer mill and represent workable and preferred particle sizes to ensure pellet integrity.

[0053] Following the processing of the shelled corn **50**, all ingredients are sent to a grain mixer to ensure uniform consistency of the mixture **52**. The mixing process should occur until a uniform mixture of all ingredients is evident to those skilled in the art. Once a homogeneous mixture is obtained, the mix is then shipped to a pellet mill **54** where the pelleting process is commenced. The ingredients are loaded into the pellet mill where the mixture is heated to a temperature of between about 125° F. to about 225° F., although preferably at about 125° F. This is accomplished to ensure flowability through the die. The pellet mill presses the mixture through a die of diameter ranging from about 1.5 mm to about 12.8 mm **56**. This process involves using a pellet mill instead of an extrusion process, through the scope of the appended claims should be construed broadly enough to support any system capable of pelletizing the aforementioned mixture of ingredients. The final product is then ready to be bagged for shipment to the customer **58**.

What is claimed is:

1. A fuel pellet comprising:
(a) Ground shelled corn, wherein the ground shelled corn has a moisture content of not more than about 15% by weight;
(b) A bonding agent;
(c) An igniting agent; and
(d) An anti-caking agent.

2. The fuel pellet of claim **1**, wherein the corn has one or more of the following characteristics:
(a) Ground shelled corn is grade 2 ground shelled corn; and
(b) Ground shelled corn has a coarseness of at most about 3.1 mm.

3. The fuel pellet of claim **1**, wherein the anti-caking agent comprises one of the following ingredients:
(a) Pulverized limestone;
(b) Dehydrated phosphorus; and
(c) Crushed egg shells.

4. The fuel pellet of claim **1**, wherein the bonding agent comprises one of the following ingredients:
(a) Soy hulls;
(b) Any type of dried distiller grain; and
(c) Milo, also known as grain sorghum.

5. The fuel pellet of claim **1**, wherein the igniting agent comprises one of the following ingredients:
(a) Wheat midds;
(b) Barley;
(c) Oats;
(d) Wheat;
(e) Any type of dried distiller grain;
(f) Speltz; and
(g) Milo, also known as grain sorghum.

6. A fuel pellet comprising:
(a) At least about 50% by weight ground shelled corn, wherein the ground shelled corn has a moisture content of not more than about 15% by weight;
(b) At most about 20% by weight bonding agent;
(c) At most about 25% by weight igniting agent; and
(d) The balance, or at most about 5% by weight, anti-caking agent.

7. The fuel pellet of claim **6**, wherein the corn has one or more of the following characteristics:
(a) Ground shelled corn is grade 2 ground shelled corn; and
(b) Ground shelled corn has a coarseness of at most about 3.1 mm.

8. The fuel pellet of claim **6**, wherein the anti-caking agent comprises one of the following ingredients:
(a) Pulverized limestone;
(b) Dehydrated phosphorus; and
(c) Crushed egg shells.

9. The fuel pellet of claim **6**, wherein the bonding agent comprises one of the following ingredients:
(a) Soy hulls;
(b) Any type of dried distiller grain; and
(c) Milo, also known as grain sorghum.

10. The fuel pellet of claim **6**, wherein the igniting agent comprises one of the following ingredients:
(a) Wheat midds;
(b) Barley;
(c) Oats;
(d) Wheat;
(e) Any type of dried distiller grain;
(f) Speltz; and
(g) Milo, also known as grain sorghum.

11. A fuel pellet comprising:
(a) At most about 75% by weight ground shelled corn, wherein the ground shelled corn has a moisture content of not more than about 15% by weight;
(b) At least about 12.5% by weight bonding agent;
(c) At least about 12.5% by weight igniting agent; and
(d) The balance, or at most about 5% by weight, anti-caking agent.

12. The fuel pellet of claim **11**, wherein the corn has one or more of the following characteristics:
(a) Ground shelled corn is grade 2 ground shelled corn; and
(b) Ground shelled corn has a coarseness of at most about 3.1 mm.

13. The fuel pellet of claim **11**, wherein the anti-caking agent comprises one of the following ingredients:
(a) Pulverized limestone;
(b) Dehydrated phosphorus; and
(c) Crushed egg shells.

14. The fuel pellet of claim **11**, wherein the bonding agent comprises one of the following ingredients:
(a) Soy hulls;
(b) Any type of dried distiller grain; and
(c) Milo, also known as grain sorghum.

15. The fuel pellet of claim **11**, wherein the igniting agent comprises one of the following ingredients:
(a) Wheat midds;
(b) Barley;
(c) Oats;
(d) Wheat;
(e) Any type of dried distiller grain;
(f) Speltz; and
(g) Milo, also known as grain sorghum.

16. A fuel pellet comprising:
(a) At least 50% by weight ground shelled corn, wherein the ground shelled corn has a moisture content of not more than about 15% by weight;
(b) At most 20% by weight bonding agent;
(c) 25% by weight igniting agent; and
(d) The balance, or at most 5% by weight, anti-caking agent.

17. The fuel pellet of claim **16**, wherein the corn has one or more of the following characteristics:
(a) Ground shelled corn is grade 2 ground shelled corn; and
(b) Ground shelled corn has a coarseness of at most about 3.1 mm.

18. The fuel pellet of claim **16**, wherein the anti-caking agent comprises one of the following ingredients:
(a) Pulverized limestone;
(b) Dehydrated phosphorus; and
(c) Crushed egg shells.

19. The fuel pellet of claim **16**, wherein the bonding agent comprises one of the following ingredients:
(a) Soy hulls;
(b) Any type of dried distiller grain; and
(c) Milo, also known as grain sorghum.

20. The fuel pellet of claim **16**, wherein the igniting agent comprises one of the following ingredients:
(a) Wheat midds;
(b) Barley;
(c) Oats;
(d) Wheat;
(e) Any type of dried distiller grain;
(f) Speltz; and
(g) Milo, also known as grain sorghum.

21. A fuel pellet comprising:
(a) At least 50% by weight ground shelled corn, wherein the ground shelled corn has a moisture content of not more than about 15% by weight;
(b) 20% by weight bonding agent;
(c) At most 25% by weight igniting agent; and
(d) The balance, or at most 5% by weight, anti-caking agent.

22. The fuel pellet of claim **21**, wherein the corn has one or more of the following characteristics:
(a) Ground shelled corn is grade 2 ground shelled corn; and
(b) Ground shelled corn has a coarseness of at most about 3.1 mm.

23. The fuel pellet of claim **21**, wherein the anti-caking agent comprises one of the following ingredients:
(a) Pulverized limestone;
(b) Dehydrated phosphorus; and
(c) Crushed egg shells.

24. The fuel pellet of claim **21**, wherein the bonding agent comprises one of the following ingredients:
(a) Soy hulls;
(b) Any type of dried distiller grain; and
(c) Milo, also known as grain sorghum.

25. The fuel pellet of claim **21**, wherein the igniting agent comprises one of the following ingredients:
(a) Wheat midds;
(b) Barley;
(c) Oats;
(d) Wheat;
(e) Any type of dried distiller grain;
(f) Any type of dried distiller grain;
(g) Speltz; and
(h) Milo, also known as grain sorghum.

26. A method for making fuel pellet, said method comprising the steps of:
(a) Following order by customer, transporting stored shelled corn to moisture tester, said shelled corn comprising less than 15% by weight of water;
(b) Transporting said shelled corn to the hammer mill for grinding to reduce the size to not greater than 3.1 mm;
(c) Transport ground shelled corn and other ingredients to grain mixer;
(d) Mix ingredients to ensure uniform consistency;
(e) Transport mixed ingredients to pellet mill;

(f) Mixture pressed through die at pellet mill to form said fuel pellets; and

(g) Bag and ship said fuel pellets.

27. A method as in claim **26**, where said die in step (f) has a size of about 1.5 mm to about 3.1 mm.

28. A method as in claim **26**, where temperature in said pressing step using die can be varied from about 125° F. to about 225° F.

* * * * *