

April 13, 1954

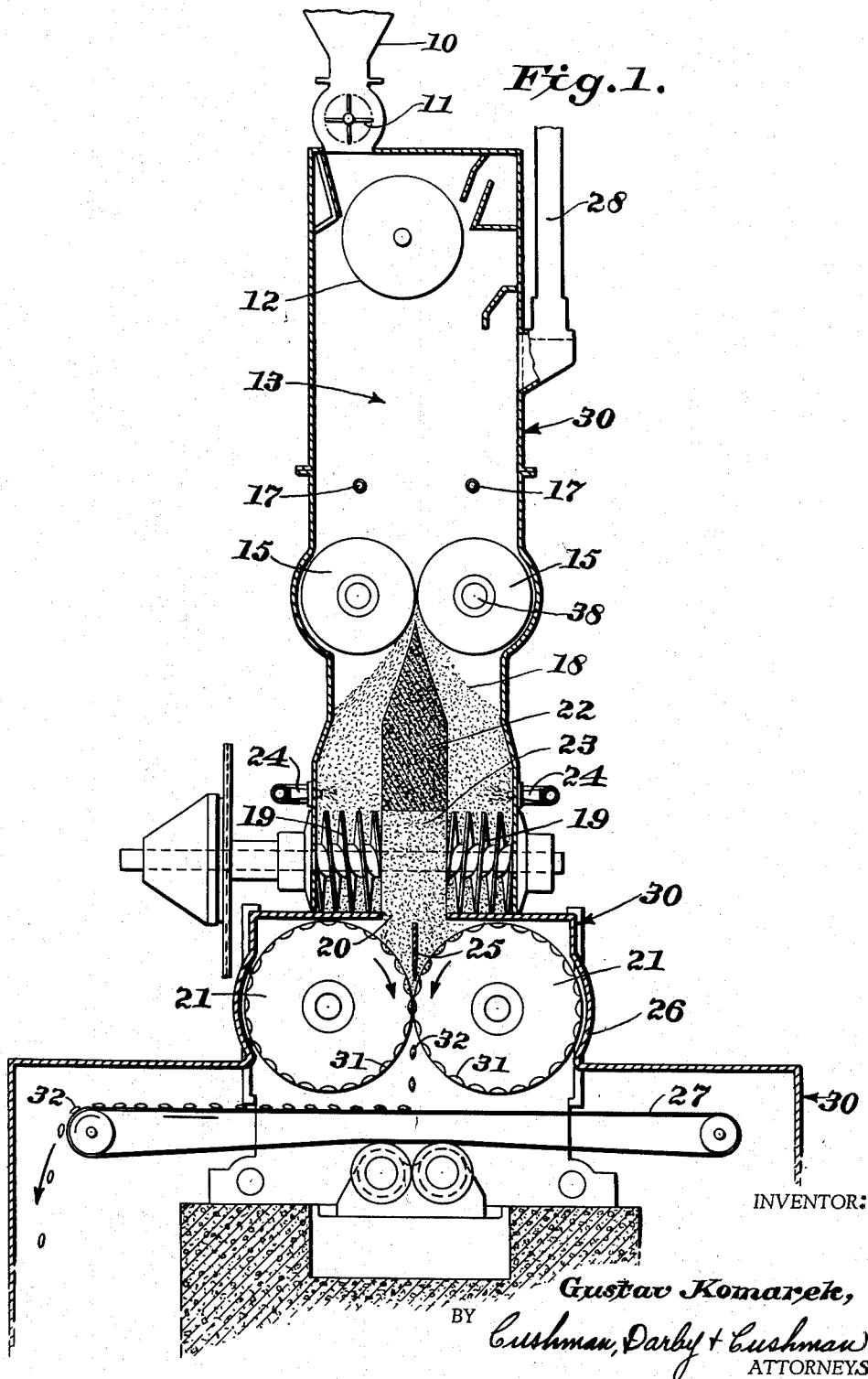
G. KOMAREK

2,675,304

BRIQUETTING

Filed Aug. 4, 1950

2 Sheets-Sheet 1



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Fig. 2.

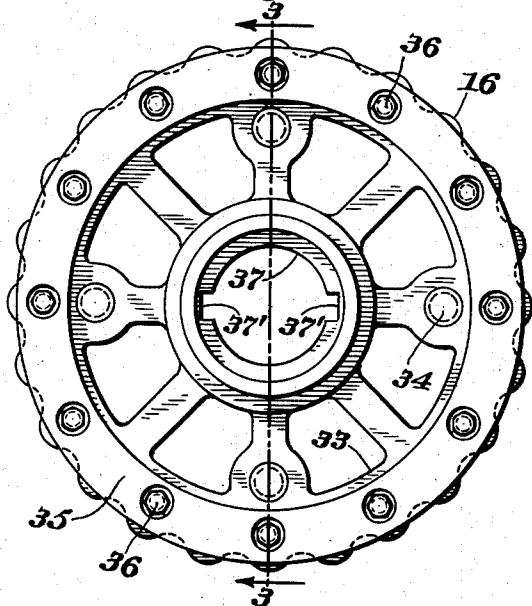


Fig. 3.

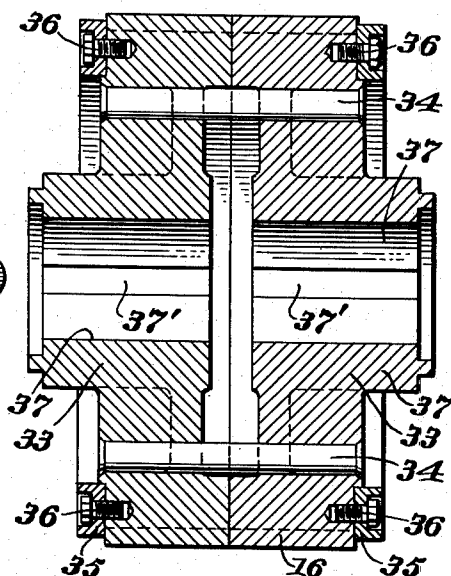


Fig. 5.

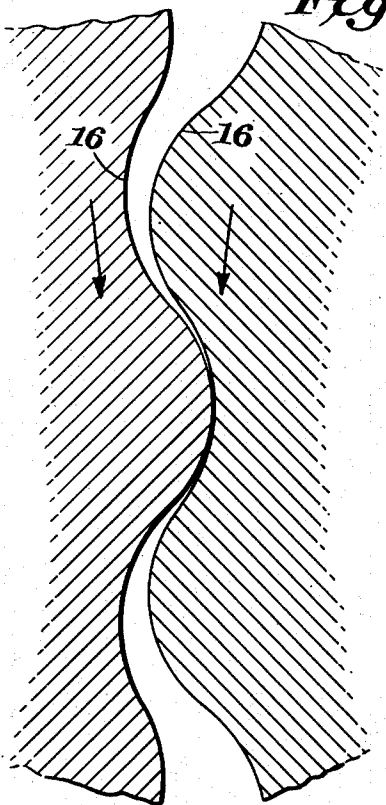
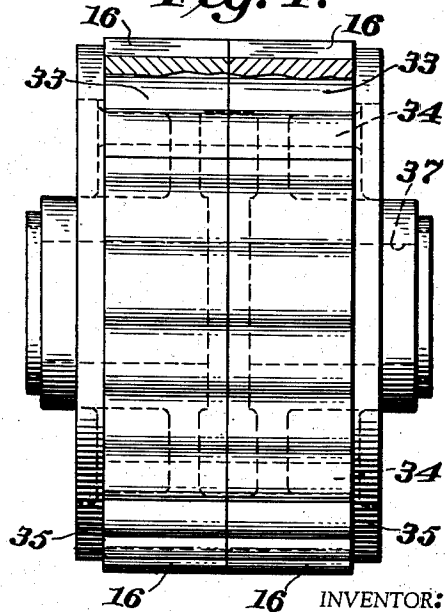


Fig. 4.



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UNITED STATES PATENT OFFICE

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BRIQUETTING

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2 Claims. (Cl. 44—10)

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This invention relates to the manufacture of nodules or briquettes, particularly useful as fuels. For instance, nodules or briquettes ranging from one twenty-fourth ounce to eight ounces in weight suitable for stokers or shovel firing can be readily formed by this invention.

The primary object of the invention is to provide a briquette or nodule which is firm, hard and abrasion-resistant.

An equally important object of the invention is to produce a briquette without the use of customary binders, reliance being had upon the natural binders present, for example, in bituminous and semi-bituminous coals and upon an improved method wherein the fuel particles are produced in a form whereby, in the press, they are oriented to have a natural interlocking relationship.

Bituminous or semi-bituminous coals usually contain one or more fossil plant residues which have been identified as resins, pollen, and peaty substances, i. e., humus. I find that these can be availed of to adhere the particles of the briquette or nodule without the necessity of the use of extraneous binders. That is, bituminous coals contain in their fossilized structure relics of plant life, that can be processed into binding elements when the coal particles are subjected to a highly concentrated pressure. Such binders act as a mucilage within the nodules or briquettes formed by the rolls, and, assisted by the pressure, serve to bind the nodules or briquettes into firm, resistant bodies entirely satisfactory for shipping, storage and combustion. Many of these natural binders are readily recognizable by well-known methods, among which are the following:

(1) *Humic tissue which has resisted the centuries of coal-forming processes.*—This material, when it occurs during the application of my process, is hydrolyzed into a peaty paste and contributes to the binding power.

(2) *Highly resinous plant remains containing resin reservoirs or gum ducts.*—These resins, or gums, are softened in the course of my process and distributed mechanically throughout the body of finely divided coal under treatment.

(3) *Pollen.*—In some coals, while there is no evidence of humic remains nor yet of great quantity of resinous matter, analysis indicates the presence of residual pollen. This forms an adhesive paste with water in the coal.

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An essential feature of the method of this invention consists in compacting and densifying the particles of the fuel mass whereby the same are deaerated and interstices between the larger particles are filled with smaller sized particles and water carrying one or more of the above-mentioned natural binders. Also, the compacting or densifying, which is conducted between closely fitting corrugated rolls forms the particles into flake-like bodies having a shale-like structure, i. e., the briquette is substantially completely formed of such particles without appreciable quantities of air or water and the particles assume a natural arrangement in which they are tightly interlocked to enhance the action of the natural cementing agents.

For purposes of a more complete understanding of the invention I have illustrated in the accompanying drawings a preferred apparatus for carrying out the improved method which, however, may be carried out by other means.

Referring to the drawings:

Figure 1 is a diagrammatic view partly in section illustrating the complete method;

Figure 2 is an end view in elevation of one of the densifying rolls;

Figure 3 is a sectional view of one of the densifying rolls taken on line 3—3 of Figure 2;

Figure 4 is an elevation of one of the densifying rolls partly broken away; and

Figure 5 illustrates in detail the manner in which the corrugations of the rotating densifying rolls are so closely related that the fuel particles are formed as flake-like bodies.

In carrying out the invention and referring particularly to Figure 1, combustible materials or fuel, notably, coal of bituminous, semi-bituminous and semi-anthracite varieties which has been previously broken up, and dried, is suitably fed to the hopper or bin 10. It is a critical feature of this invention that the moisture content of the coal fed to the bin 10 should not be above about 3%, and preferably is between about 1% and 2%. The coal is dried at temperatures up to about 200° F. to the aforesaid free moisture content, and then at a temperature from normal atmospheric (70° F.) to about 100° F. and the moisture content indicated, is delivered to the bin. The presence of a critical amount of free water precludes loss of small coal particles in

dusting, prevents oxidation and exerts a chemical function, namely, to improve the binding action of the humus and pollen.

The coal is fed by means of the usual star wheel 11 to a conventional hammer mill 12 where it is ground to a mesh size between about 30 and 200. Preferably, the coal is ground to a fineness so that about 90% to 98% of it will be smaller than 100 mesh. A much smaller percentage, e. g., about 5% to 12% will be ground to extreme fineness of colloidal size of about one-half micron up to 200 mesh. It is in the smaller size fractions of the mass that the binder-making ingredients will be found, namely, the humus, resins and pollen. Following the hammer mill operation and as an optional step, the coal may be subjected to a rolling between plain rolls if the hammer mill grinding does not produce fine enough granules. Some coals require greater fineness than others, i. e., the hard coals require greater fineness.

It is desirable that the maximum particle size after comminution in the hammer mill or hammer mill and plain rolls be no greater than 100 mesh, but a mesh size as coarse as 30 mesh may be used in this invention with some coals. The coal body is composed of various elements of varying hardness. The effect of the intense comminution in the hammer mill is to divide into the coarser size (100 mesh or thereabout) the harder mineralized coal elements, i. e., vitrain, durain, and hard components of the ash, while the softer elements, when present, i. e., fusain, resins, humic matter, pollen, etc. are by the same action comminuted into much smaller particles—from 200 mesh down to the colloidal and near colloidal sizes. These small sizes are picked up by the water, mechanically, and without chemical action, in the case of the gums and resins, and, in the case of the humic bodies and pollen, hydrolyzed into pastes. This intense grinding action also serves most thoroughly to mix the fine water-carried particles amid and among the coarser harder particles. There is thus evolved an efficient binding material from vegetable residues in the coal body.

From the hammer mill 12 the coal drops into a conventional surge hopper 13 which is a chamber having both ends open. Through the bottom open end of the surge bin the broken fuel particles are delivered directly to the bight of a pair of rotating compacting and densifying rolls 15 which are shown in detail in Figures 2 to 5. These rolls have intermeshing corrugated surfaces 16, as illustrated in Figures 2 and 5, and are distinguished from plain, pre-compression rolls heretofore used. The corrugated rolls 15 do exert a direct grinding pressure, as is the case with plain rolls, but, as illustrated in Figure 5, in addition, simultaneously exert a compacting and deaerating effect by twisting, compressing and forming the particles as small flake-like bodies after the manner of shale formation. The important result of this treatment and one which is absolutely necessary to produce a firm, hard and a brasion-resistant briquette is the unusually complete deaeration which is obtained.

As the coal is introduced to the bight of the corrugated rolls 15, it is preferably, although not necessarily, subjected to steam having a temperature from atmospheric up to about 300° F., the steam being introduced through suitable nozzles 17. This steam facilitates the densification and deaeration in that the steam further assists in driving out the air.

The coal from the deaerating and compacting rolls 15 is discharged into a column 18 and this coal, as explained, is in the form of small flake-like bodies having the form of a shaledified structure. The shaledified bodies are of about one-fourth to one-eighth inch in thickness and may be of various areas.

Stated another way, the treatment in the intermeshing corrugated rolls, as distinguished from plain rolls, takes the ground coal in which there were millions of voids and produces a flaked product wherein the number of voids, relatively speaking, are reduced to hundreds. The use of the steam in the densifying action is optional but preferable since it adds a small amount of moisture to enhance the carrying effect of the original moisture of the coal in dispersing the natural binders and also in replenishing moisture which may have become lost. Moreover, the steam excludes air, as stated above, and in connection with the natural binders, such as humus and pollen, renders them more effective chemically to exert their adhesive action.

In the column 18 the shaledified particles build up, as indicated in Figure 1, upon the conveyor structure 19. This conveyor structure is located at the bottom of the column and comprises two screw conveyors forming pressure feeders disposed in opposed relation which operate to direct the fuel centrally so that it may pass from the column through the slot or discharge opening 20 disposed over the bight of a pair of briquetting rolls 21. The chamber or column 18 may have any desired height, about twenty to forty inches being satisfactory, and the flakes are fed to the column at a temperature from atmospheric up to 300° F., depending upon whether or not steam is injected through the nozzle 17 into the fuel supplied to the pre-compression or densifying corrugating rolls 15. The column 18 preferably extends about thirty inches above the screw feed 19 and, as explained, the delivery opening 20 of the conveyor structure is disposed so as to deliver the particles directly into the bight of the briquette rolls 21 of the press.

Referring to Figure 1, it will be appreciated that the rotation of the rolls 21 of the press not only bights into the fuel delivered from the opening 20 of the column 18, but, as I have found, exerts an upward pressure on the body of fuel delivered through the opening 20. The provision of the column 18 substantially prevents objectional extrusion of the coal upwardly because a portion 22 of the fuel in the column 18 always remains substantially static. This forms a dense head of coal which exerts a pressure directly upon the portion of fuel 23 delivered to the center of the column by the conveyor structure 19, i. e., directly over the delivery opening 20 and the bight of the briquette rolls 21. In other words, the relatively more dense column or head of fuel 22 above the delivery outlet opening 20 constantly resists the upward pressure exerted by the briquette rolls and causes the coal to pass uniformly through the outlet in a deaerated condition so that the briquette rolls 21 bight into a dense mass of fuel at all times. Experience has shown that unless the column 18 is provided, a satisfactory briquette is not formed. The static column 22 remains throughout feeding of the coal from the outlet opening 20 to the briquette rolls 21 and the weight of this column forces the material delivered in the central space between the opposed conveyors 19 downwardly into the bight of the briquetting rolls and, at the same time,

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the presence of this head excludes air from the particles fed to the press.

If desired, and it is usually preferable, steam at a temperature of about 200° F. to 300° F. is introduced to the coal in the column through nozzles or jets 24. This steam has the effect of further eliminating air, and of rendering the natural binders more immediately active to adhere the particles in the briquetting rolls. The use of live steam at about 50 p. s. i. boiler pressure is further important in that it brings the coal to a good pressing temperature, eliminates the tendency to "clam shelling" and also reduces dusting.

That the coal has been substantially deaerated is definitely indicated by the complete lack of explosive and cracking noises during briquetting or nodulizing in the press rolls 21. Normally, in the briquetting operation noises are produced resembling machine gun fire. This is eliminated by the use of the intermeshing corrugated rolls of the pre-compression densifying and compacting step, and by the provision of the column 18 which provides for delivery to the briquette rolls 21 of a constant dense deairified body of particles.

Furthermore, whereas the coal fed from the densifier to the chamber or column 18 had the voids reduced to hundreds, as indicated above, the briquettes produced from the flake-like particles, as described above, are substantially free of voids. Moreover, in the briquettes, the particles are arranged in natural interlocking positions whereby the briquette is hard throughout the particles are tightly bonded, not only by natural binders, but also by the interlocking of the particles.

The briquetting operation may utilize any suitable briquetting machinery, but, preferably, the operation is conducted with high pressure rolls, namely, a pressure of 20,000 pounds to 30,000 pounds p. s. i. The ability to form satisfactory briquettes and nodules, without extraneous binders, in a roll-type press constitutes a new departure in the art of briquetting. The resultant briquettes are firm, hard and abrasion-resistant. Where the natural binding agent in the nodules or briquettes consists largely of resins, the product grows stronger in storage, in much the same manner as linseed oil increases in strength with age and exposure.

Referring to Figure 1, a flat bar 25 is positioned between the briquette rolls 21, in the nip thereof, the purpose of which is to prevent two great a quantity of coal from being compressed between the rolls. As indicated, the bar is situated above the medium line or axis of the rolls and extends across the face width of the rolls.

As shown in Figure 1, the briquetting rolls are rotatably mounted in a housing 26 and the briquettes, as formed, drop upon a travelling conveyor 27 of any suitable character to discharge the briquettes to a suitable location.

The entire operation from the star feeder 11 to the conveyor 27 is carried out under air tight conditions, and one or more air outlets or vents 28 are located in the closed system for instance, at the hammer mill, as shown.

Referring to Figure 1, the entire apparatus is enclosed in an air tight casing or chamber 30 having one or more air vents 28 with the parts in vertical or superposed relation as shown. The bin 10, feeder 11 and mill 12 may or may not be enclosed in the housing, the bin and feeder being shown outside of the same and the mill within the housing 30. In any event, means of conventional

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character are provided for continuously or intermittently supplying material to the bin 10 and it is thus delivered by gravity to the other instrumentalities within the casing 30. The surge hopper portion 13 of the casing forms a passage or conduit for material from the mill 12 to the corrugated rolls 15 and the column 18 forms a passage for material from the rolls 15 to the press 21. It will be noted that the parts are preferably positioned in vertical alignment, the bights of the rolls 15 and 21 and the opening in the passage or column 18 being in substantial alignment as shown.

The rolls 21 have mating briquette or nodule forming recesses 31 in their surfaces and the formed briquettes are shown at 32 which are removed away from the rolls by the conveyor 27 also located in the chamber 30 as shown.

The rotatable corrugated rolls 15 having intermeshing surfaces are shown in detail in Figures 2 to 5. Each roll is preferably cast as complete roll sections 33 shown in Figure 3 with corrugated surfaces 16 and connected together by transversely extending bolts, rivets or other suitable means 34 as shown in Figure 4 inwardly of the corrugated surfaces of the rolls. Wear and guard rings 35 are secured to the exposed end or side of each section 33 by bolts 36 as shown. The central bearings 37 of the sections are transversely spaced apart as shown in Figures 3 and 4 and each is provided with a key-way 37' in transversely aligned relation whereby each of the rolls may be keyed to a rotating shaft 38 shown in Figure 1. The various instrumentalities are driven in any suitable manner to provide a continuous or intermittent operation.

It is desirable with some types of coal to use wet binders. In such cases, lower briquetting pressures are employed. By wet binders is meant binders which are melted or melted and mixed in the presence of steam, i. e., the binder is made fluid so as to coat the coal particles. Tall oil or tall oil pitch in small percent is used, namely, one-half of 1% up to 3% on the dry weight of the coal. These binders are introduced and mixed with the fuel in the surge hopper or into the column 18 below the rolls 15 by any suitable means.

Also, binders, can be used which need not be the type requiring melting, in which event, the binder is mixed in with the coal before it is fed to the hammer mill. Pulverant binders of this type are coal tar pitch, petroleum asphalt, dry sulfite liquor, dry starch, etc. and molasses may be used also.

I claim:

1. The process of forming briquettes and nodules which comprises passing coal particles of about 30 to 200 mesh size containing natural fossil plant residues and having a free moisture content not in excess of about 3% through intermeshing corrugated rolls and thereby deaerating, densifying and forming the particles into flake-like shafled bodies, and compressing masses of the bodies between rolls into briquettes.

2. The process of forming briquettes and nodules which comprises passing coal particles of about 30 to 200 mesh size containing natural fossil plant residues and having a free moisture content not in excess of about 3% through intermeshing corrugated rolls and thereby deaerating, densifying and forming the particles into flake-like shafled bodies, forming the bodies in a vertical column having a portion thereof constantly more highly densified and deaerated and thereby creating a head, delivering the bodies from the

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column directly to a press at a point beneath and under pressure exerted by said head, and compressing masses of the bodies between rolls into briquettes.

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