

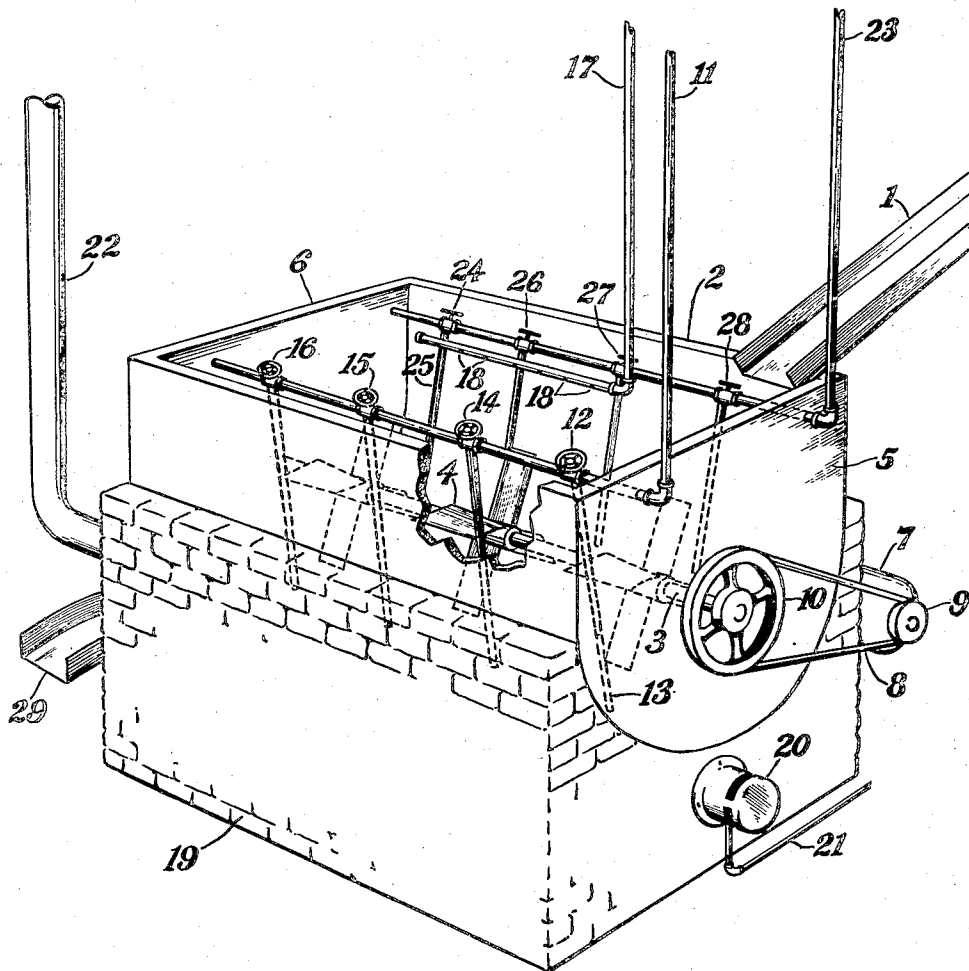
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APPARATUS FOR PREPARING COAL DUST FOR BRIQUETTING

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APPARATUS FOR PREPARING COAL DUST
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This invention relates to machinery which is suitable for preparing coal dust for briquetting under widely varying conditions of the initial coal dust.

Coal dust is not a uniform material but varies in its characteristics such as moisture content, particle size, B. t. u. content, et cetera, within very wide limits depending upon the source of the dust, both as to its natural origin and as to the manner of handling which reduced it to the form of dust.

One object of this invention is to provide a machine which will be simple enough to operate by the average worker, and which will yield satisfactory results regardless of the nature of the dust from which the briquettes are made.

It is intended that in this apparatus, briquettes may be made of a small enough size to be used conveniently and economically in the average domestic stoker, as well as in industrial boilers. Briquettes of approximately the size and shape of peach or prune pits are admirably suited to this purpose, being easily handled by the conveying screws of the stokers, and also being easily charged into the hoppers. They also make an excellent and easily controlled fire. The manufacture of suitable briquettes of this size and shape, however, presents some difficulties because of the large surface area compared to the weight. This ratio tends to produce rapid drying and setting of the binder throughout the entire briquette with a resulting brittleness that produces a high ratio of breakage of the briquettes during transit and storage. Also due to the small size, it becomes extremely important to have the binder thoroughly mixed with all particles of the coal dust, because even a small dry spot will destroy a briquette of such small size.

Satisfactory briquettes of this type are far better for use in domestic stokers than raw, sized coal, because they contain no foreign matter which has not been reduced to at least $\frac{1}{8}$ inch. There is nothing, therefore, to hang up in the screw and cause the shear-pins to shear. One of the briquettes, itself, should it become caught between the screw and the conveyor tube will merely crush, since it has even less structural strength than the coal from which it was made.

Our object is, therefore, to provide an apparatus which will produce satisfactory briquettes of small size from coal dust which is normally wasted at the mines, frequently being a serious problem of disposal.

In accordance with the present invention, the steps of the process to be performed in my novel

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apparatus and related equipment, are as follows:

1. Screening of the dust so that no particle is larger than about $\frac{1}{8}$ inch in diameter. If the dust contains a large percentage of larger particles, it will be found advantageous to crush them prior to the screening operation.

2. Simultaneous application of direct heat, mechanical agitation and moisture content correction. If the moisture content is too low, it must be increased. If too high, it must be reduced. Moisture is readily added by injecting steam into the mixture. Moisture content may be reduced by aeration and use of higher temperatures. We have found that it is most suitable when the free moisture is held between 5 per cent and 15 per cent, by weight, of the mixture. The heat must be sufficient to produce steam within the mixture.

3. Application of a binder. This is done while the mechanical agitation of step 2 is continuing and the heat is still being applied. Any customary binder, preferably of the bituminous or petroleum types well known in the art, is satisfactory for this purpose. The addition of a compatible emulsifying agent (also well known) together with the generation of steam within the mixture, which makes it light and fluffy, causes the binder to rapidly and completely permeate the entire mixture.

4. Aeration to speed drying and setting of the binder.

5. Briquetting between rolls. This follows step 4 without lapse of time so that the binder will not set before the mixture is formed into briquettes.

To aid in performing this process, we have invented apparatus to carry out steps 2 through 4 of the process. A preferred embodiment of this invention is shown in the drawing. The coal dust is screened, or crushed and screened, by means of commercially available equipment designed for this purpose, the details of which do not form a part of this invention, and which are, therefore, not shown in the drawing. The screened dust is discharged from the screening machine through chute, 1, directly into the mixing mill, 2. This mill has a semicircular bottom and contains a shaft, 3, running its full length, parallel to the bottom and located at the center of curvature of the bottom. Mounted on the shaft are paddles, 4, which agitate the mixture and force it from the entering end, 5, towards the leaving end, 6. The shaft, together with the paddles affixed thereto, is rotated by a conventional motor, 7, and conventional drive means

such as a belt, 8, operating over sheaves, 9 and 10.

Steam is admitted through pipe, 11, from a conventional boiler (not shown). Valve, 12, is opened to admit the steam through the nozzle, 13, extending downward into the coal dust being mixed. When the coal dust is very dry, the next valve, 14, is also opened. Valves, 15 and 16, may also be opened for unusually dry dust, thus adding additional steam into the body of the mix. By providing the individually operable valves, we have thus made it practical to handle dusts of widely varying moisture content in the same apparatus.

While I have shown in the drawing that the nozzles extend downwardly inside the mill, it is, of course, understood that they might be arranged on the outside of the mill with just the tip of the nozzle extending through the wall of the mill at the same approximate locations.

The binder is pumped under pressure from the storage tank (not shown) through pipe, 17, and sprayed through openings, 18, in the horizontal portion of the pipe directly onto the mix. The binder readily mixes with the coal dust under the agitation of the paddles, 4, especially because the dust is light and fluffy from the action of the steam and also the direct heat applied as described hereafter.

In order to bring the entire mass of coal dust quickly up to the proper temperature for the formation of steam from the moisture contained initially in it and to prevent the condensation of excess moisture from the steam introduced as described above, we have mounted the mixing mill on a base of firebrick or other material which will stand the heat, 19. Within the chamber thus formed, heat is generated by a conventional burner, 20, from fuel oil or gas supplied through pipe, 21. The application of this heat directly to the bottom of the mixing mill makes it possible to rapidly bring the entire mix up to the proper temperature, which is above the boiling point of water. The products of combustion are exhausted through the stack, 22, at the far end.

As the mix approaches the discharge end, 6, of the mill, it is aerated by means of compressed air supplied by a conventional air compressor and storage tank (not shown) through pipe, 23. Valve, 24, is opened permitting the compressed air to enter near the bottom through nozzle, 25. This aeration removes excess moisture and conditions the binder for more prompt setting as the mix is discharged into the briquetting rolls. When the coal dust initially contains excessive moisture, it is necessary to increase the aeration and to introduce the air nearer to the inlet end, 5, of the mill. Under such conditions, valve, 26, is opened, and even valves, 27 and 28, may be opened under extreme moisture conditions. The air pipes might also be arranged outside the mill similarly to the method outlined for so arranging the steam pipes.

By thus providing individually operable valves in the compressed air line similar to the ones in the steam line, it becomes very simple to regulate the amount of moisture in the mixture so that it is held to the correct amount for proper mixing of the binder and proper working in the briquetting rolls. Either excess or deficient moisture initially is quickly and easily corrected while the binder is being mixed with the coal dust. Thus within a matter of minutes after the dust is

screened, and without any additional storage facilities for the intermediate steps, the entire process of preparation for the briquetting rolls is carried out in one single mill, and the properly prepared mix is ready to be discharged through chute, 29, directly into a set of conventional briquetting rolls (not shown). This direct action also eliminates the possibility of having the mix set too long after the binder is added and before being briquetted which makes the finished briquettes brittle even if they can be made at all. This is especially important with the small size briquettes suitable for use in domestic-type stokers because of the higher ratio of surface area to cubic content than exists in larger size briquettes. This ratio promotes more rapid curing after leaving the rolls, but it also accentuates any tendency to brittleness. Brittleness, of course, causes much more loss in transit, and any means of reducing it produces a saving in usable product.

Having now described both the apparatus and its method of operation, we claim as our invention:

1. Apparatus for preparing coal dust for briquetting, comprising: a mixing mill having a charging end and a discharge opening at the opposite end; said mill having means for agitating the coal dust continuously and simultaneously conveying said dust from the charging end to the discharge opening; a steam supply pipe with a plurality of nozzles arranged to introduce steam into the coal dust in said mill; a compressed air supply pipe with a plurality of nozzles arranged to introduce air under pressure into the coal dust in said mill; said steam and air nozzles being arranged progressively along the path of travel of the dust and individually valved so that any portion of the steam and air nozzle valves may be closed, thus permitting steam to be introduced along a portion of the travel and air along a later portion and also permitting variation of the point where introduction of steam ceases and introduction of air begins; a liquid binder supply pipe arranged to spray liquid binder onto the coal dust in said mill; means to convey mixed coal dust and binder from the discharge opening directly to briquetting rolls; and means for applying heat directly to said mill in sufficient quantity to raise the temperature of the coal dust above the boiling point of water.

2. The apparatus of claim 1, wherein the means for applying heat comprises a controllable flame applied directly to the bottom of the mill within a confined space.

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