Jan. 21, 1941. H. ADAMS 2,229,235

METHOD AND APPARATUS FOR THAWING FROZEN FUEL

Filed Oct. 22, 1937

Fig. 1.

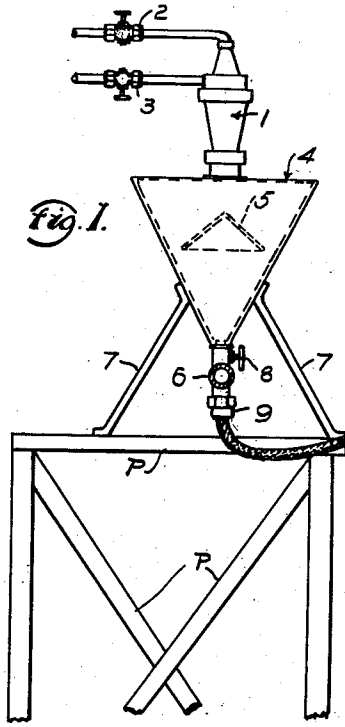
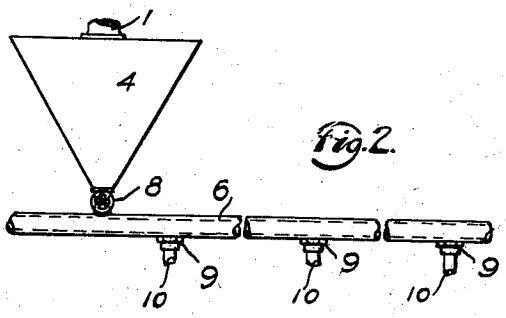


Fig. 2.



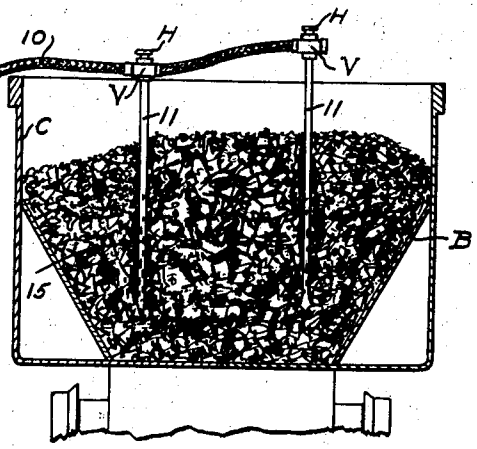


Fig. 4.

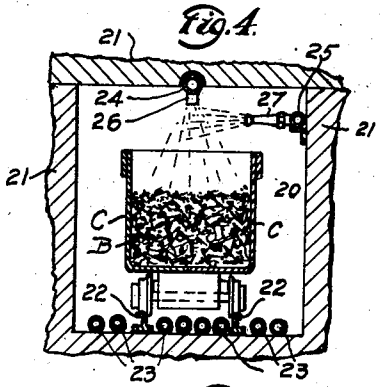


Fig. 5.

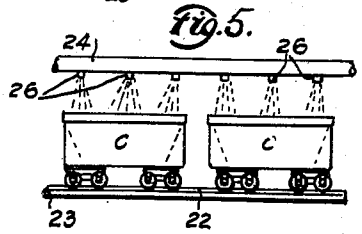


Fig. 6.

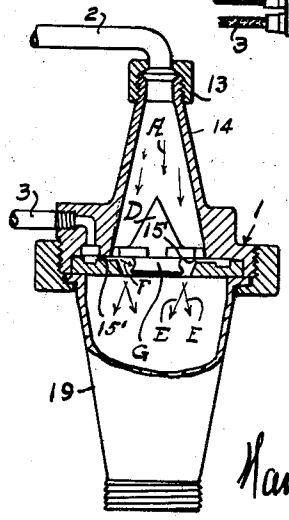
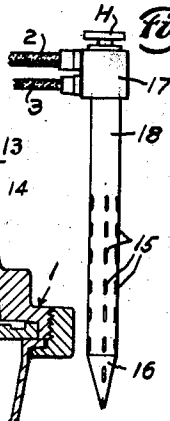


Fig. 3.



INVENTOR:
Henry Adams,
BY
Harold D. Penney
ATTORNEY

Patented Jan. 21, 1941 2,229,235

UNITED STATES PATENT OFFICE

2,229,235

METHOD AND APPARATUS FOR THAWING FROZEN FUEL

Henry Adams, Plainfield, N. J.

Application October 22, 1937, Serial No. 170,425

25 Claims. (Cl. 61—36)

The present invention relates to an improvement in a method of thawing frozen coal and an improvement in frozen coal thawing devices such as may be used, in winter, to thaw out piles of exposed commercially sized coal or coke, in piles, or in coal carrying cars, wherein the coal has been exposed to the weather and becomes so frozen as to prevent its removal or transfer from the piles or from the transport means.

In present practice, one method of thawing frozen coal is to insert steam nozzles deep into the body of the frozen coal, and then force live steam into the interior of the frozen pile of coal at about 150 lbs. pressure, until it is thawed out. While this practice is effective, it is extremely expensive, as vast volumes of steam are used, and the process of thawing the coal under this practice is slow.

In coal thus exposed any length of time to the winter weather, in piles, or in the transporting coal cars, it becomes stratified in its frozen condition, due to alternate weather thaws and freezing, so that, eventually the bottom portion of the coal in the pile or in the cars, being protected by the overlying coal from weather thaws becomes substantially a solid frozen body, and the interlying strata of the coal, between the exposed top layers and the solid frozen bottom layer becomes more frozen, into different degrees of solidity, gradually, from bottom to the exposed top. Each weather thaw tends to thaw the top layers and the water seeps down to the under layers and is there held to again freeze, until eventually, the coal becomes a solidly frozen mass, the bottom layers of which are always more solidly frozen than the upper and top layers.

Live steam at 150 lbs. pressure has a temperature of approximately 358.2 F., and has a humidity or moisture content of about 30 to 40 percent. Steam under the above condition admitted to the coal pile, as previously noted, and as has been discovered, does not quickly nor economically thaw the coal, as, due to its high pressure vast volumes of the steam quickly thaws its way out and is lost to atmosphere long before its latent heat becomes useful.

It has been discovered, and this discovery forms the subject matter of the present application, that an increase of humidity in the steam, in a higher proportion than may be obtained in live steam from a boiler, greatly increases the speed of thawing the coal, and greatly reduces the expense, because, as has been found in actual, current practice, less steam is required to thaw out a given volume of coal over the known practice previously above outlined.

In the present improvement, it is proposed to use the boiler, hose and steam nozzle means heretofore used in current practice, but to introduce modifying structures and means therein, whereby to (1st), reduce the amount of thawing live steam used per given volume of frozen coal, (2nd) to create a fog like mist of high humidity as a means for better dispersion of heat within and without the frozen coal body, (3rd) thereby saving steam and fuel, (4th) to apply the heated fog at a relatively low pressure within the frozen coal thus to slow down its escape discharge from the pile, permitting the frozen coal to absorb more of the latent heat of the fog and finally, thawing the coal at a faster speed than heretofore accomplished, thus effecting a further saving of fuel and steam.

In one of the improved embodiments herein, by providing a humidifier in the steam line from the boiler to the thawing nozzle, the introduction of sprayed water into the live steam stream before its introduction into the frozen pile, causes the formation of what I call an artificial fog, wherein the humidity or moisture content of the steam is increased to about 96%, and the pressure and temperature is correspondingly reduced, therefore due to reduced pressure the heated fog remains longer in the body of coal and more completely passes its latent heat to the surrounding coal.

This artificial fog, when introduced into the coal pile, penetrates the frozen coal more quickly than live steam, and more slowly leaves the same, and thus remains longer in the frozen coal because of its loss of pressure by humidifying, and the coal is quickly thawed out in less time than with live steam. The increase in efficiency, in time, amounts to about 40% to 60% over the high pressure live steam method, for a given bulk of coal being treated.

In another form of thawing of coal in 50 ton capacity coal cars, the cars may be moved into an enclosing steam shed, and there treated in such closed sheds, thus conserving the heated, comminuted moisture which forms the fog, as it leaves the interior of the coal in the cars; instead of letting it escape to waste in atmosphere as is now done in live steam thawing, where the thawing is done in the open; and the coal is exteriorly surrounded by an outer, continuously circulated envelope of heated fog and the frozen coal is thus attacked from within and without, simultaneously.

The foregoing and other features of advantage will be apprehended as the herein description proceeds, and it will be obvious that modifications may be made in the structures herein without departing from the spirit hereof or the scope of the appended claims.

In the drawing,

Fig. 1 is a fragmentary partially sectioned view, in elevation of the present apparatus applied to a coal car for thawing purposes;

Fig. 2 is a fragmentary, longitudinal view, in elevation, of a steam and water mixing and atomizing humidifier nozzle structure;

Fig. 3 is an enlarged side view of a modified form of steam and water mixer nozzle;

Fig. 4 is a transverse sectional view, more or less diagrammatic showing a modified use of the present invention wherein the thawing of the car is done in an enclosing, closed steam or fog shed;

Fig. 5 is a more or less diagrammatic view in elevation showing the relative positions of the coal cars and the water atomizing means spray and nozzles; and

Fig. 6 is a fragmentary longitudinal sectional view of the steam and water atomizer nozzle, which is identical with the atomizer head shown in my United States Patent #1,785,803, issued Dec. 23, 1930.

While the herein disclosure is directed to thawing frozen fuel such as coal and coke, it is obvious that it may be utilized to thaw out other frozen materials such as sand, crushed ores and the like, and it is to be understood that any reference to coal or fuel is inclusive of these other materials.

The present system of thawing frozen coal comprises the use of a steam boiler generating plant, not shown, but well understood, steam being conducted from said boiler through a valved connection **2**, Fig. 1, into a water atomizer head **1**, said head being substantially a duplicate of the head shown in Fig. 6, except as to outside dimensions of the foregoing noted U. S. patent.

This head as shown in Fig. 6, herein, is so constructed as to receive steam at one end which flows in the direction of the arrows A, to the constricted medial Venturi ports in the direction of arrows E, being so directed by cone D, where the steam stream traverses a plurality of radially incoming water streams from a source of water supply, not shown traveling in the direction of the arrows F, towards the axis of the head, the steam intercepting the water streams and heating and atomizing the same and then both traveling as a heated mist or fog, in the direction of the arrows E, to pass thence into the baffle plated mixing and expanding chamber **4**, Fig. 1.

The incoming, radially directed jets of water which come directly from surrounding port **15'**, impinge upon a curved impact seat G, which is located upon the expanded perimeter of the cone D, and this aids, with the dynamic flow of the steam stream, to atomize the water and to admix the steam therewith.

As the fog mixture passes into the chamber **4**, which may be cone shaped and which may be mounted upon a platform P, Fig. 1, it is interrupted and redirected by a cone shaped baffle **5** shown dotted in Fig. 1. The mixture then passes by the perimeter of the baffle to and through coupling valve connection or hand valve **8**, to distributor pipe **6**, and thence through couplings **9**, and thence through flexible hose coupling **10**, which latter is provided with steam point connectors V—V, by which the tubular steam point or fog nozzles **11** are operatively attached to said hose connection **10** and to the source of pressure fog supply **4**. The supply of atomized water and steam may be supplied to chamber **4** so that the pressure of the contained fog may be maintained at about 40 to 50 lbs., with or without the operation of the hand valve **8**, which is mainly used to shut off the fog when removing the steam points. The fog points **11**, at their hose line connections or couplings are each provided with an anvil head H, whereby said points may be driven, by a hammer, into the frozen coal, to the positions indicated in Fig. 1, wherein the car C having a load of coal B therein is shown as having a pair of steam points embedded in the body of the coal. Any number of steam points and mixing chambers **4**, may be used as a unit in a thawing operation as is indicated in Fig. 2. The steam points **11—11**, of Fig. 1, may be provided with sharpened ends **16** and, with discharge slits **15** along their cylindrical surfaces, as in Fig. 3, whereby the fog may escape to the coal.

In Fig. 3 there is shown an alternative form of nozzle, generally denoted as **18**, and which comprises a cylindrical fog discharge tube having a cone like end, an atomizer head **17** being connected to the opposite end of the tube, which head has thereon an anvil head H, for driving the sharpened tube **16** into the frozen coal, that portion of the point between its mid-section and point being provided with a plurality of fog emitting slits **15**.

This atomizer head may be constructed to mix steam and atomized water into a fog, as described for the device of Fig. 6, the head being served by a steam supply connection **2**, and a water supply connection **3**, to operate as described for the atomizer head **1**, of Fig. 1.

In Fig. 4 there is shown an enclosed chamber **20**, defined by surrounding walls **21**, the opposite ends of the chamber being closed by doors, not shown, whereby car loads of coal C may be run into the chamber on the tracks **22**, and the doors then closed, to retain the heated fog as generated.

Within the chamber and located over the cars is a main water distributor pipe **24**, Figs. 4 and 5, and this pipe may be provided with a plurality of water spraying heads **26**, whereby water may be sprayed upon the coal in a fine mist. As in Fig. 4, the mist is traversed by an angular blast of live steam, which emits from live steam nozzle **27**. The dynamic action of these right angle discharged streams creates a vast quantity of very warm foggy mist, the heat of which is gradually transferred to the coal.

On the track level, below the cars C, are arranged a plurality of pipe lines **23**, these being connected to a source of live steam, which passes through said pipes thereby causing them to act as a heating radiator for keeping the thawing temperature constant within the chamber **20**, for heating the thawing fog within said chamber and to prevent condensation of the fog therein. The fog acts as a capable heat circulating means within the chamber **20**.

In practice the water used for creating the fog, may be mixed, in suitable proportions, with dissolved deliquescent salts, such as calcium chloride, or chloride of sodium; sea water may be used as a fog making aggregate with the steam. These added elements, over fresh water, tend

to lower the freeze point of the water, and further hasten the thawing of the coal.

From the disclosure herein it is obvious that the low pressure steam and water fog created as herein described, when distributed within the bulk of the frozen coal, disperses slowly through the bulk thereof and transfers its latent heat slowly throughout the bulk, and does not thaw out crater-like channels to atmosphere, as in current high pressure steam practice, where the dispersion is slight, but its discharge to atmosphere is too rapid, after it cuts discharge vents in the bulk, and discharges too much of its heat to atmosphere, without time to cause proper dispersion through the frozen bulk.

It is further obvious, that where loaded coal cars are brought into the fog chamber or shed 21, that the structure of Fig. 1 may be used to thaw out interior of the frozen bulk fuel while the fuel is being thawed by the surrounding fog within the shed, and which fog will be augmented by the fog discharged from within the body of the coal. The heat from the radiator piping beneath the coal car also rises and directly attacks the more solidly frozen lower strata of frozen coal within the car.

What is claimed is:

1. A method of thawing weather exposed, frozen bulk coal, which consists in commingling a dynamic stream of water and a dynamic stream of live steam, thereby to create a fog, and directing the fog into the body of the frozen bulk coal.

2. A method of thawing weather exposed, frozen bulk coal, which consists in increasing the normal humidity of a high pressure stream of live steam by introducing water into said stream to create a hot fog of relatively low pressure, and directing the hot fog into the body of the frozen coal.

3. A method of thawing frozen bulk fuel which consists in subjecting the bulk fuel interiorly and exteriorly to a hot fog in a closed chamber.

4. A method of thawing frozen bulk fuel which consists in subjecting the bulk fuel exteriorly of its bulk to a hot fog in a closed chamber, and simultaneously maintaining the temperature of the hot fog by heating the same from a separate heat source.

5. A method of thawing frozen bulk fuel which consists in subjecting the interior of the bulk fuel with a hot fog comprising commingled steam and atomized water at low pressure, the fog having a humidity of about ninety percent.

6. The combination with an apparatus for thawing frozen bulk coal, including a source of water and live steam supply, of a steam and water atomizing head, a mixing, discharging and humidifying container connected to said head, a conduit connected to said container and a plurality of fog discharge nozzles connected to said conduit.

7. The combination with an apparatus for thawing frozen bulk fuel, including a source of water and live steam supply, of a baffled mixing, discharge and humidifying chamber, steam and water atomizing means discharging into said container, connections between said atomizing means and said steam and water source, means for separately regulating said steam and water supply to said atomizer, a flexible conduit connected to said discharge chamber, bulk insertible fog discharging nozzles connected to said conduit and means for controlling the volume of fog discharge therefrom.

8. The combination with an apparatus for thawing frozen bulk fuel, including a source of live steam and water supply, of an enclosed fog thawing chamber said chamber for cars with frozen bulk fuel therein, and live steam and water atomizing and commingling nozzles therein for creating a fog within said chamber to surround a car of frozen bulk fuel, to thaw the same.

9. The combination with an apparatus for thawing frozen bulk fuel, including a source of live steam and water supply, of an enclosed fog chamber for cars with frozen bulk fuel therein, live steam and water atomizing and commingling nozzles connected to said supply sources for creating a fuel thawing fog within said chamber and heat radiating means within said chamber for maintaining said fog at predetermined fuel thawing temperatures.

10. In the art of thawing frozen bulk coal, a method which comprises separately conducting to a mixing point water, and live steam having about 30 to 40 percent moisture; mixing said water with the steam at said point in a proportion to give to the mixture about 96 percent moisture; and introducing said mixture into the interior of the bulk coal for thawing the bulk.

11. A method as in claim 10 comprising additionally heating the bulk by radiation during said thawing.

12. In the art of thawing frozen bulk coal, an apparatus which comprises means for intimately mixing with a stream of live steam enough water to provide a heavy fog, thereby to increase the thawing power of the mixture; and means for delivering said mixture to the interior of the bulk coal for thawing the bulk.

13. An apparatus as in claim 12 comprising means for supplying additional heat to said bulk during the thawing for retarding cooling and condensation of the fog and maintaining the efficiency and thawing power of the fog.

14. Apparatus as in claim 12 comprising a heating means for supplying additional heat to the bulk during thawing, and means enclosing the heating means, the delivering means and said bulk to confine the heat of the fog and heating means to the bulk, and thereby effect saving of the heat of the fog and the heating means for increasing the efficiency of the heating thereof.

15. A method of thawing frozen bulk fuel in a closed chamber, which comprises filling a large portion of said chamber exterior to the coal with hot fog; and subjecting bulk fuel in said chamber sufficiently to said hot fog to effectively thaw the coal.

16. A method as in claim 15 in which the fog is heated from a separate source of heat.

17. A method comprising exposing frozen broken bulk fuel in a closed chamber filled to hot fog, hot enough and sufficient in quantity to effectively thaw the coal.

18. A method as in claim 17 comprising heating said hot fog from a separate source of heat.

19. In the art of thawing frozen bulk coal, a method which comprises separately conducting water and live steam to a mixing point; mixing said water with the steam at said point to form a hot fog and applying said fog to the bulk coal in sufficient quantity to effectively thaw the bulk.

20. A method as in claim 19 comprising additionally heating the bulk by radiation during said thawing.

21. In the art of thawing frozen bulk coal, a method which comprises separately conducting to a mixing point, water and live steam; mixing said water with the steam at said point in a

proportion to give to the mixture increased moisture; and introducing said mixture to the interior of the bulk coal for thawing the bulk.

22. In the art of thawing frozen bulk coal, a method which comprises introducing to the interior of the bulk coal a hot fog containing about 96 percent moisture, for thawing the bulk.

23. A method as in claim 22 comprising additionally heating the bulk by radiation during said thawing.

24. In a fog generating means, the combination of a fog generating head having a discharge opening; means for supplying water and steam into said head and therein atomizing and mixing them and discharging the atomized mixture at said discharge opening; a large humidifying chamber having a discharge end, and a wall across its other end provided with an opening in register with said discharge opening; and a baffle across said chamber spaced from the side walls of the chamber.

25. In a fog generating means, the combination of a fog generating head having a discharge opening; means for supplying water and steam into said head and therein atomizing and mixing them and discharging the atomized mixture at said discharge opening; a large cone-shaped humidifying chamber having a narrow discharge end, and a wall across its large end provided with a central opening and secured with said central opening in register with said discharge opening, the discharge opening discharging into the chamber; and a cone shaped baffle in said chamber coaxial with the chamber and said openings and spaced from the side walls of the chamber and pointing toward said openings.

HENRY ADAMS.