April 28, 1942. J. A. HYSON ET AL 2,281,497

METHOD OF MIXING FUELS

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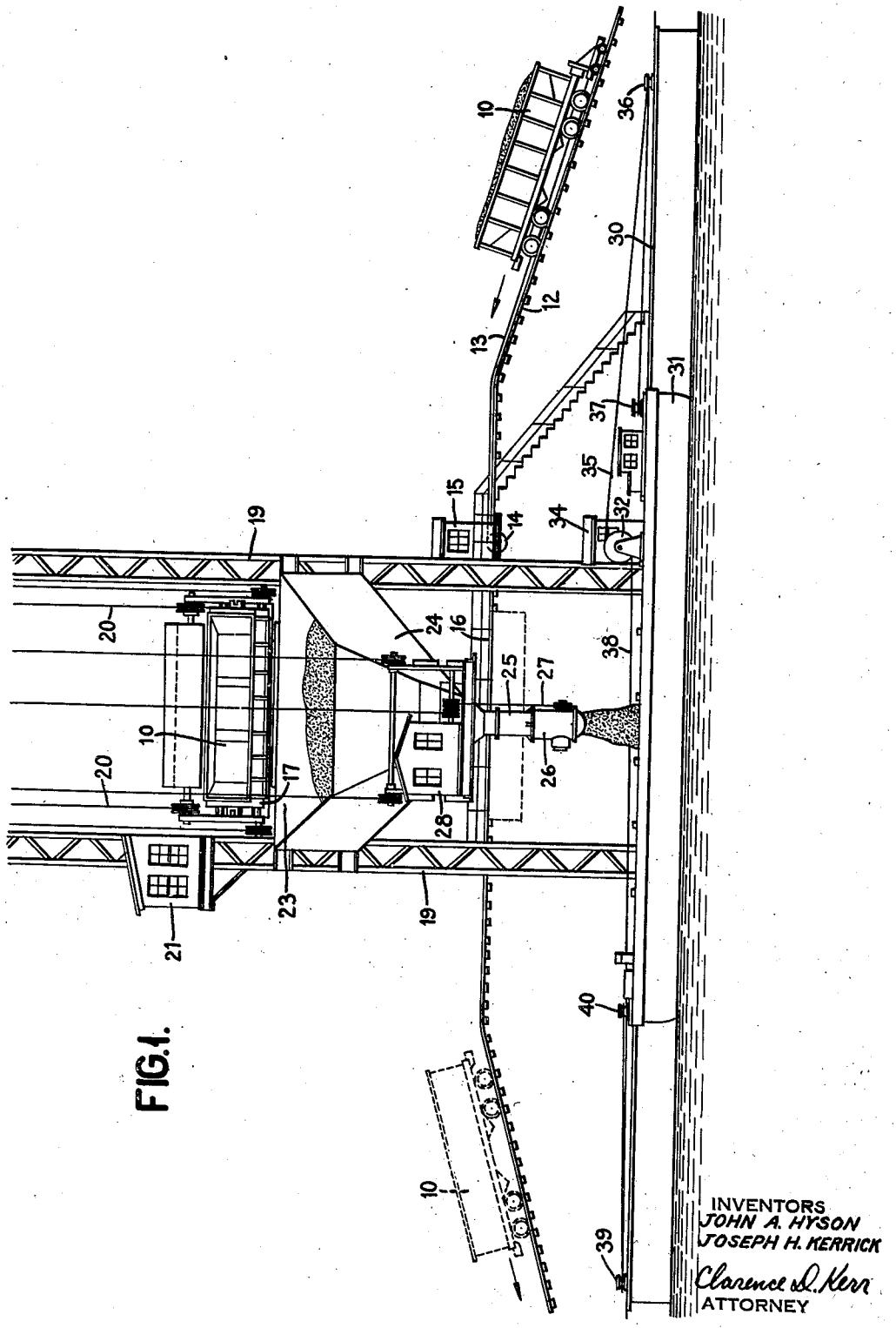


FIG. 1.

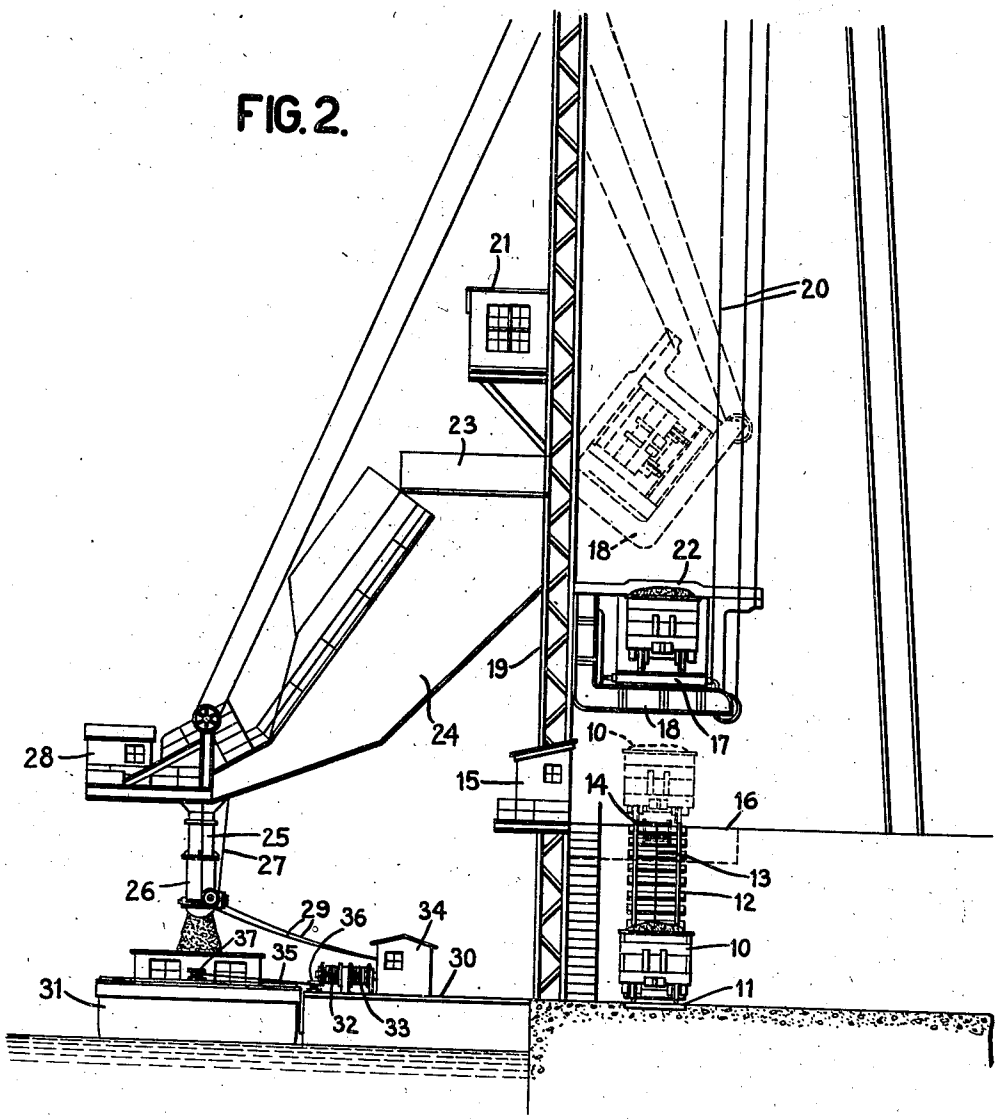
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FIG. 2.



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FIG. 3.

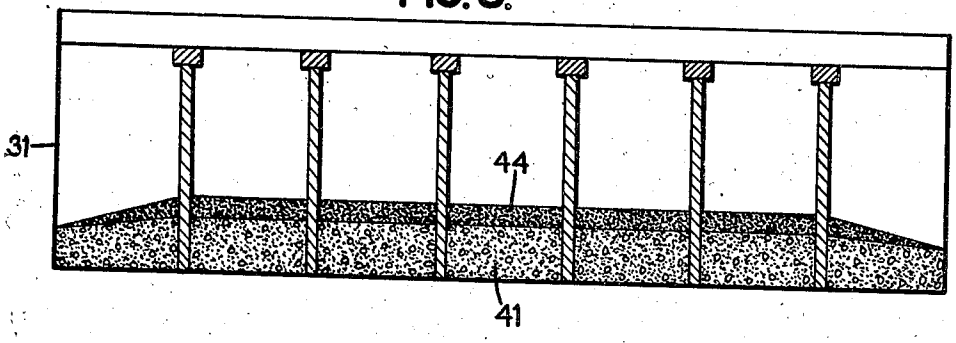


FIG. 4.

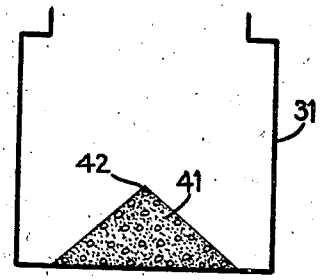


FIG. 5.

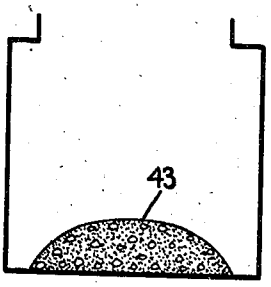


FIG. 6.

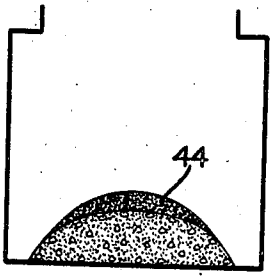


FIG. 7.

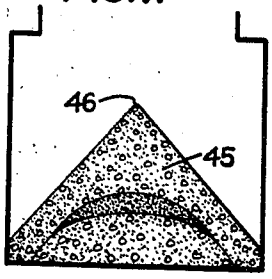


FIG. 8.

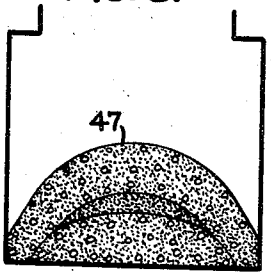
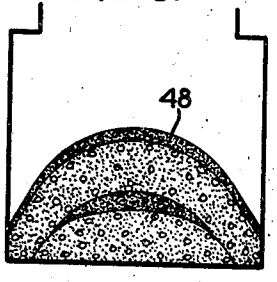


FIG. 9.



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FIG. 11.

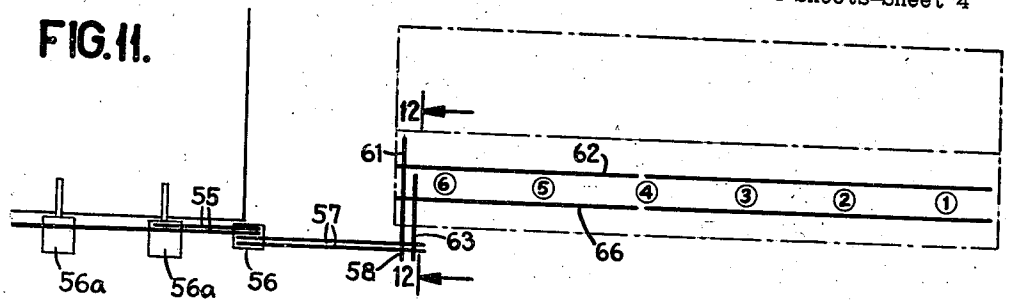


FIG. 12.

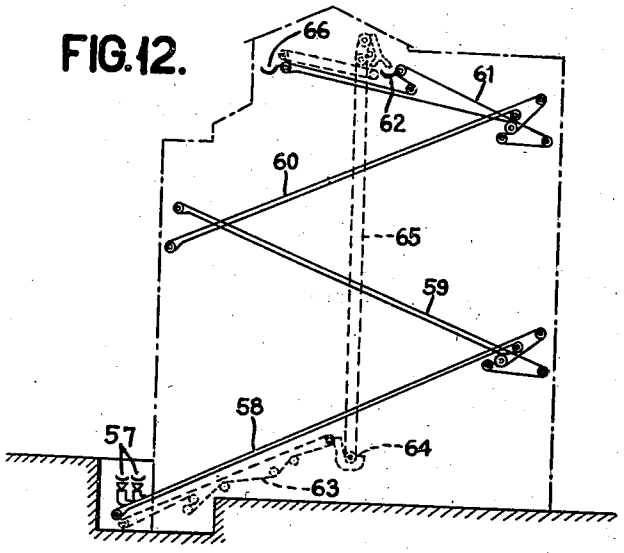
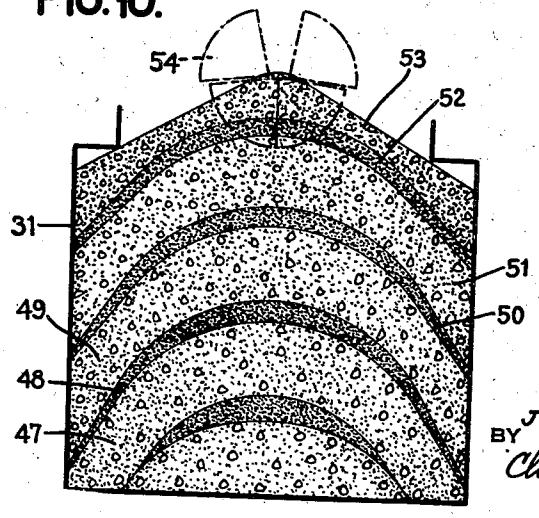


FIG. 10.



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Patented Apr. 28, 1942

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UNITED STATES PATENT OFFICE

2,281,497

METHOD OF MIXING FUELS

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Application July 6, 1939, Serial No. 282,968

6 Claims. (Cl. 259—1)

This invention relates to an improved method of mixing solid fuels. It has particular reference to the production of a mixture of bituminous and anthracite coals specially suited for use in the firing of underfeed stokers which are subject to substantial variations in load.

In the production of such mixtures it is important to obtain a thorough and intimate intermixture of the bituminous and anthracite coals. However, the expense of such intermixture must be kept as low as possible in order to make the use of the mixture commercially practicable. Accordingly, it is a special feature of the invention to provide for the intermixture of the different types of fuel entering into the final product in the normal course of handling and transferring the same from the railroad terminal, or the like, to the point of use. The method provided for this purpose may be employed with little, if any, additional expense over that normally involved in the regular handling and conveyance of the fuels.

Briefly, the invention involves the dumping of the coal in alternate layers of bituminous and anthracite into a barge, boat or other means of conveyance used for transporting the fuel from one point, such as a railway siding, or the like, to an unloading point adjacent the point of use. At the unloading point a grab bucket, or the like, capable of biting through two or more layers of the fuel, is used to remove the fuel from the barge. This serves to bring together, in the approximately correct proportions, the two types of coal, at the same time effecting a certain degree of intermixture. In the subsequent handling of the coal by means of a series of belts or bucket conveyors, with the dumping of the coal a number of times from one conveyor to another, a more thorough intermixture is obtained.

Other features, objects and advantages of the invention will appear from the detailed description of the illustrative method which will now be given in conjunction with the accompanying drawings, in which:

Figure 1 is a front elevational view of the apparatus employed for loading a barge.

Figure 2 is a side elevational view of this apparatus.

Figure 3 is a longitudinal, sectional view through the barge, partly loaded.

Figures 4 to 9, inclusive, are schematic views in transverse section through the barge, indicating successive stages in the loading of the barge.

Figure 10 is a similar schematic view on a larger scale, showing the barge fully loaded and indicating a grab bucket used in the unloading of the coal, and

Figures 11 and 12 are schematic views illustrating in plan and elevation, respectively, the conveyor system employed at the barge unloading terminal for transferring the coal to the point of use.

Referring now particularly to Figures 1 and 2 of the drawings, there is shown the apparatus for loading the coal or similar solid fuel into a barge. The fuel is delivered to the loading apparatus in an open railway car 10, arriving on a track 11 at the level of the ground at the loading point. The car is then drawn up on a trestle or inclined section of track 12 by means of a cable 13 having a hook or other fastening means at its end adapted to be attached to a suitable portion of the car. The cable is wound upon the drum of a winch 14, which may be operated by any suitable power means, such as an electric motor, under the control of an attendant in the control house 15. By means of the cable 13 the loaded coal car is brought to the lower level 16 of a platform 17 of an appropriate car-elevating structure. In Figure 2 the elevator is shown, in full lines, intermediate its upper and lower positions. The car may be drawn onto the platform 17 by means of the cable 13, sufficient momentum being imparted to it for this purpose.

The elevator may be of any conventional and desired form, capable of lifting a loaded car and tilting it through an angle of 90° or more to dump its contents. It may suitably comprise a pair of spaced, angular supporting members 18 adapted to travel upwardly along suitable guideways provided in a pair of towers or columns 19. When the elevator has been raised to the point indicated in broken lines in Figure 2, it is tilted about an appropriate pivot provided adjacent the upper ends of the angle members 18. Cables 20, under the control of an operator in a control house 21 above the dumping point, serve to rock the elevator about its pivot through the required angle. To retain the car in a fixed position on the tracks of the platform 17, during the dumping operation, any suitable anchoring means, such as cross-members 22, may be provided. These cross-members extend over the top of the car and serve to clamp it firmly against the tracks. It will be understood that the cross-members are suitably bolted or otherwise clamped to the frame of the elevator.

As a loaded car is tilted by the elevator through an angle of 90°, its contents will be dumped into a hopper 23 at the top of a chute 24, which serves

to deliver the coal to a down spout 25. This down spout may be of a conventional telescopic construction adapting it to be lengthened or shortened, as desired. The lower member 26 of the spout is also adapted to be turned about its vertical axis into any desired position and it carries a gate, preferably of the rotary type, at its lower end for either closing off the spout or opening it to any desired extent. Swivel and gate constructions of this character are well known and may be of any suitable and conventional form. Turning of the lower portion of the down spout about its vertical axis may be effected by a cable 27 operated under the control of an operator in a control house 28. The opening and closing of the gate may be controlled by cables 29 extending to a suitable point on the dock 30 along the side of which the barge 31 is positioned for appropriate manoeuvering. An operator, stationed on the dock 30 in a position to observe the loading of the barge, may operate the cables 29 for opening and closing the rotary gate, as desired.

During the loading operation the barge 31 is shifted back and forth longitudinally beneath the down spout to insure the proper distribution of the coal in layers throughout the length of the barge. For the purpose of so shifting the barge, a pair of winches 32 and 33 is provided, these winches being under the control of an operator in a control house 34. A cable 35, wound upon the drum of the winch 32, is passed around a post 36 fixed to the dock 30 at a point beyond the right end of the barge (Figure 1) when the latter is shifted to its extreme righthand position. The end of the cable 35 is secured in any desired way to the end of the barge, as by means of a loop thrown around a post 37. A similar cable 38, wound upon the drum of the winch 33, is passed around a post 39 carried by the dock at a point beyond the left end of the barge (Figure 1) when the latter is in its extreme left-hand position. The end of cable 38 is attached in any suitable way to the end of the barge, as by means of a loop thrown around a post 40.

It will be understood that the winches 32 and 33 are adapted to be driven by power from any suitable source, such as an electric motor, and are arranged to be rotated in opposite directions under the control of an operator in the control house 34. Accordingly, as the cable 35 is being wound upon its drum, the cable 38 will be unwound and the barge will be shifted toward the right in Figure 1. When the winches are reversed, and the cable 38 is wound while the cable 35 is unwound, the barge will be shifted toward the left in Figure 1. If desired, the two cables might be wound upon a single drum in such a way that one would be wound on one end of the drum while the other is being unwound from the other end of the drum. However, the employment of separate winches enables the use of simple loops at the ends of the cables to be thrown over the posts 37 and 40 and permits the cables to be separately drawn taut in the handling of barges of different lengths.

In the operation of the loading apparatus, the bituminous and anthracite coals are alternately dumped into the hopper 23 by the tilting of the elevator, although a number of cars of bituminous will be dumped for each car of anthracite dumped. As will be explained, the preferred mixture for underfeed stokers, subject to high peak loads, is substantially 80% of bituminous coal and 20% of anthracite, by weight. To provide this preferred mixture it has been found desirable in loading a barge of 1000 tons capacity to first elevate and dump two cars of the bituminous coal, each car being of 50 tons capacity. As these cars are being dumped, the barge will be shifted from end to end at a sufficient speed to enable the coal to be distributed in an elongated pile of substantially uniform cross-section extending from one end of the barge to the other. For this purpose the speed of travel of the barge may appropriately be about ½ foot per second, although the speed may be varied to suit the particular requirements. In cross-section the pile or ridge of coal will be substantially as indicated at 41 in Figure 4. In introducing this and subsequent layers of bituminous, the gate of the down spout is preferably left wide open so as to offer no obstacle to the flow of the coal, which may contain a substantial quantity of large lumps. The first layer or load of bituminous is not spread to the extreme sides of the barge but the peak 42, indicated in Figure 4, is eliminated by the spreading of the top portion of the elongated pile into the rounded form indicated at 43 in Figure 5. This spreading or trimming of the coal may suitably be done by manual labor.

After the two carloads of bituminous have been introduced into the barge and trimmed, a 50-ton car of anthracite is delivered to the elevator and dumped into the chute 24. This anthracite is then spread over the top of the ridge of bituminous forming the first layer, by the movement of the barge longitudinally beneath the down-spout. At this time the speed of movement of the barge is preferably increased to about 1 foot per second and the gate at the lower end of the down-spout is partially closed so that the opening through which the coal is discharged is only about ¼ or ⅓ the maximum available. This is for the reason that the anthracite flows freely, like sand, and the single carload of 50 tons would not be distributed throughout the length of the barge if its movement were not speeded up and the gate of the down-spout partially closed. In practice it has been found desirable to completely close the gate of the down-spout as the last hatch adjacent the end of the barge passes beneath the down-spout. This guards against the accumulation of an excessive amount of the fuel at the ends of the barge.

The rate of movement of the barge and the rate of discharge of the fuel into the barge may be such that the complete load of bituminous or anthracite, as the case may be, will be deposited upon a single movement of the barge in one direction or these rates may be such that a complete reciprocation of the barge, or several to-and-fro movements of the barge, are required to deposit each layer. As the barge is shifted beneath the down spout the member 26 may be turned or oscillated, if desired, by the operator in the control house 28 so as to bring about a more uniform spreading of the coal. Trimming of the bituminous might be avoided in this way. However, in practice it has been found best to leave the spout in a position in which the coal will be directed in a direction opposite to that in which the barge is being shifted. It will be understood that the lower end of the downspout has a tendency to direct the coal in a definite direction away from the vertical axis of the spout particularly when the gate is partially closed. Accordingly, in the preferred practice the member 26 is swung 180° about its axis as the barge reaches each end of its travel so that the coal

will be thrown in the opposite direction from the vertical center line of the spout as the movement of the barge is reversed.

Upon completion of the introduction of the first layer or load of anthracite coal, designated **44** in Figure 6, the two layers will present in cross-section substantially the appearance indicated in Figure 6. No trimming of the top layer of anthracite is necessary since it has a normal tendency to flatten out as indicated. It will be observed that even at this stage little or no coal is spread to the extreme side edges of the barge.

Another layer of bituminous coal, as indicated at **45** in Figure 7, is now introduced, in the same manner as the first layer. This second layer of bituminous is preferably 200 tons, in the production of the preferred mixture with the aid of a 1000-ton barge, so that four 50-ton cars of bituminous are dumped into the hopper **23** for the formation of the layer. As indicated in Figure 7, a substantial deposit of fuel will have been spread from this second bituminous layer to the extreme side edges of the barge. After trimming of the peak **46** to provide the rounded effect indicated at **47** in Figure 8, another 50-ton layer **48** (Figure 9) of anthracite is introduced and spread over the second layer of bituminous, this being accomplished, without trimming, by the simple movement of the barge beneath the down spout, in the same manner as the first layer of anthracite.

This operation of introducing successive layers of bituminous and anthracite is continued until the capacity of the barge is reached. The member **26** of the down spout may be lowered at the beginning of the loading process and then raised as the barge becomes filled or it may be left continuously with its discharge end at substantially the level of the top of the barge to minimize loss of the fine particles in the air. The successive layers of bituminous are preferably in 200-ton quantities, when the barge is of 1000-ton capacity, while the successive layers of anthracite are preferably 50 tons. Figure 10 illustrates the arrangement of the succeeding layers **49**, **51** and **53** of bituminous and **50** and **52** of anthracite. It will be understood that the successive layers of bituminous require trimming while the successive layers of anthracite do not. The top layer **53** of bituminous, however, need not be trimmed and this layer preferably is reduced to 100 tons, corresponding with the lowermost layer. The quantities of coal employed in the several layers may, of course, be varied to suit particular requirements. Thus the ultimate proportioning of anthracite and bituminous may vary, as will be later explained and even in arriving at the same proportions the number of layers and the quantities of coal employed in the successive layers may be varied. Some variation is necessarily brought about through the impossibility of insuring the presence of a precise amount, such as 50 tons, of coal in each car. However, in general it is best to form the top and bottom layers of bituminous and preferably of somewhat less magnitude than the intermediate bituminous layers. An advantage in topping off with bituminous coal is that it serves to shield the anthracite which would be likely to take on more moisture in the event of rain.

After the barge has been loaded in the manner indicated, the cables **35** and **38** are disconnected from it and it is towed to the unloading point. Here, the coal is removed from the barge, preferably by means of a grab bucket **54** (Figure 10) carried by a derrick or unloading tower **56***a* of conventional design, schematically shown in Figure 11. As illustrated in Figure 10, the grab bucket should be of such capacity and shape as to dig through or bite into at least two layers of the coal upon each operation. This, in view of the distribution of the coal in the various layers, insures substantially the correct proportioning of bituminous and anthracite coal for each load of the grab bucket. It has been found, upon analysis of the final coal mixture obtained from the operation of the grab bucket upon different portions of the load in the barge, that the proportioning of bituminous to anthracite is maintained substantially uniform. There is, of course, a slight variation but the variation is well within permissible limits.

The grab bucket is arranged to discharge the coal onto one or both of a pair of horizontal conveyors **55**, preferably of the bucket type, adapted to transfer the material from the unloading dock to a point where it may be elevated into the bunkers for final disposition. In depositing the coal upon the conveyor **55** it becomes partially intermixed. If desired, the coal may be weighed at a weighing house **56** and it may be transferred after weighing to one or both of another pair of conveyors **57**. At the opposite end of the travel of the conveyors **57** the coal may be dropped onto a conveyor **58**, which is the first of a series of conveyors for transferring the coal to the top of the building in which it is to be utilized. It will be understood that appropriate hoppers and chutes or other guide means are provided for receiving the coal as it is discharged from one conveyor and delivering it to the next conveyor. At the opposite end of the travel of the conveyor **58** the coal is similarly discharged to another conveyor **59**, which in turn discharges the coal to still another conveyor **60** that delivers the coal to a further conveyor **61**. It will be apparent that any suitable number of conveyors, of the belt or bucket type, may be employed for elevating the fuel to the top of the building in which it is to be utilized. Upon each transfer of the fuel from one conveyor to another a substantial intermixture takes place. At the conclusion of four or five of these transfers the intermixture is quite thorough and the fuel will be found to be ready for use in the manner contemplated.

In the typical installation illustrated, the conveyor **61** is adapted to discharge the fuel into a horizontal conveyor **62** which traverses a series of bunkers into which the fuel is then discharged and from which the fuel is fed, by means well known and, therefore, not shown, to a boiler stoker. In this typical installation, one of the two conveyors **57** is arranged to deliver the fuel to the conveyor **58**, as previously explained, while the other is arranged to deliver the fuel to a conveyor **63**, which in turn delivers it at **64** to a vertical, bucket-type conveyor **65**. The latter is arranged to deliver the fuel either to the horizontal conveyor **62** or to another horizontal conveyor **66** which is likewise adapted to discharge the mixture into the bunkers for use. The belt conveyor **61** may, if desired, be adapted to deliver the fuel to the horizontal conveyor **66**, in lieu of the conveyor **62**. The proportioned coal taken from the layered material in the barge by means of the grab bucket is thoroughly mixed by the time it reaches the bunkers regardless of which of the conveyor systems it may have followed.

By preventing the anthracite from spreading freely to the edges of the barge, which is in part

accomplished by the timely opening and closing of the gate of the down spout, the presence of an excessive amount of anthracite in any portion of the mixture is avoided. An excessive amount of anthracite would so increases the moisture content of the mixture as to cause trouble in its use.

In general it may be said to be desirable to employ between 70 and 80% of bituminous and between 20 and 30% of anthracite in the mixture. The two types of coal, as already explained, should be thoroughly intermixed. The bituminous employed is preferably run of the mine and of a low volatile variety. Its volatility is preferably between 16 and 22%, although coal of higher volatility may be employed for some purposes. Its moisture content may be between 3 and 4%, its fixed carbon between 70 and 75%, its sulfur content between 1 and 2%, its ash between 5 and 8% and it may have a B. t. u. value of 14,000 or more.

The anthracite is preferably a fine buckwheat commonly designated #4. Its particles preferably range from $\frac{3}{64}$'' to $\frac{3}{32}$'' and it flows much like sand. It may suitably be the material which will pass through a $\frac{3}{32}$'' screen and will pass over a $\frac{3}{64}$'' screen. Not more than 5% of the material should be oversize and not more than about 25% should be undersize. There should be substantially no sub-mesh material in the anthracite. An excess of oversized particles tends to pass too much carbon to the ash while an excess of undersized particles tends to develop packing in the fuel bed with resulting uneven distribution of air and the formation of blow holes if the air pressure is increased to offset the packing. The anthracite volatile matter should range from about 4 to 8%, the moisture from about 8 to 12%, the fixed carbon from about 70 to 80%, or slightly higher, the ash from about 10 to 12%, and the sulfur should be less than 1%. Its as received B. t. u. value is somewhat lower than the bituminous and will ordinarily be between 11,500 and 13,000.

While a particular method of producing an improved fuel mixture has been described in considerable detail, it should be understood that the method may be modified in a variety of ways without departing from the general principles and scope of the invention. The terms and expressions employed herein have been used as terms of description and not of limitation.

The method and apparatus disclosed herein for loading a carrier, such as a barge, and the method and means identified therewith for aiding the intermixture of different types of solid fuels, has been made the subject of a divisional application Ser. No. 372,626, filed on December 31, 1940. So also the improved fuel mixture disclosed herein has been made the subject of a divisional application Ser. No. 372,627, filed December 31, 1940.

We claim:

1. A method of intermixing a plurality of different solid fuels as an incident to the transfer thereof from a supply point to a delivery point which comprises distributing the several fuels in successive layers in a carrier at the supply point, removing the fuel from said carrier at the delivery point in such a way as to take successive portions of the fuel from the top and from a plurality of layers at a time, the amounts of the different fuels removed each time being in substantially the proportion in which they are disposed in the layers, and dumping each of the successive portions a plurality of times in the course of conveying the same to the point of use.

2. A method of intermixing anthracite and bituminous coals as an incident to the transfer thereof from a supply point to a delivery point, which comprises distributing said coals in alternate layers of bituminous and anthracite in a carrier at the supply point, removing the coal from the carrier at the delivery point by taking portions from each of a plurality of layers at the top upon successive removals, the amounts of anthracite and bituminous coals removed each time being in substantially the proportion in which they are disposed in the layers, and dumping each of said removed portions a plurality of times in the course of conveying the same to the point of use.

3. A method of intermixing anthracite and bituminous coals as an incident to the transfer thereof from a supply point to a delivery point, which comprises distributing said coals in alternate layers of bituminous and anthracite in a carrier at the supply point, trimming each layer of bituminous before the next layer of anthracite is distributed, removing the coal from the carrier at the delivery point by taking portions from each of a plurality of layers at the top upon successive removals, the amounts of anthracite and bituminous coals removed with each portion being in substantially the proportion in which they are disposed in the layers, and dumping each of said removed portions a plurality of times in the course of conveying the same to the point of use.

4. A method of intermixing anthracite and bituminous coals as an incident to the transfer thereof from a supply point to a delivery point, which comprises distributing a layer of bituminous coal over the bottom of a carrier by introducing the same along the longitudinal center line thereof, trimming the top of said bituminous layer, distributing a layer of anthracite over the trimmed bituminous by introducing the same along the longitudinal center line of the carrier, repeating said distributing and trimming operations all at the supply point until the carrier is filled by a plurality of layers of bituminous and anthracite coals alternately disposed, removing successive portions of the coal from the top of the carrier, the amounts of anthracite and bituminous removed in each portion being in substantially the proportion in which they are disposed in the layers, and conveying the removed portions in such a manner as to cause the coal therein to become mixed in the course of delivering the same to the point of use.

5. A method of intermixing authracite and bituminous coals in desired proportions as an incident to the transfer thereof from a supply to a delivery point, which comprises discharging the coals alternately in the proper ratio from an outlet at the supply point, shifting a carrier relative to said outlet in such a manner as to cause the coal to be distributed in successive layers alternately of the bituminous and anthracite along the longitudinal center line of the carrier, varying the speed of said relative shifting of the carrier and outlet, said speed being substantially greater while the anthracite is being discharged from the outlet than while the bituminous is being discharged, removing successive portions of the coal from the carrier at the delivery point, each portion being taken from

a plurality of layers and containing the anthracite and bituminous in substantially the proportion in which they are disposed in the layers, and causing each portion of coal so removed to become thoroughly mixed in the course of conveying the same to the point of use.

6. A method of intermixing anthracite and bituminous coals in desired proportions as an incident to the transfer thereof from a supply to a delivery point, which comprises discharging the coals alternately in the proper ratio from an outlet at the supply point, retarding the flow from the outlet as the anthracite is being discharged, shifting a carrier relative to said outlet in such a manner as to cause the coal to be distributed in successive layers alternately of bituminous and anthracite along the longitudinal center line of the carrier, increasing the speed of said relative shifting of the barge when the anthracite is being discharged, removing successive portions of the coal from the carrier at the delivery point, each portion including coal from each of a plurality of layers and containing the anthracite and bituminous coals in substantially the proportions in which they are disposed in the layers, and causing each portion of the coal so removed to become thoroughly mixed in the course of conveying the same to the point of use.

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