Oct. 30, 1956 M. L. COVER 2,768,890

METHOD OF SINTERING

Filed April 27, 1951 3 Sheets-Sheet 1

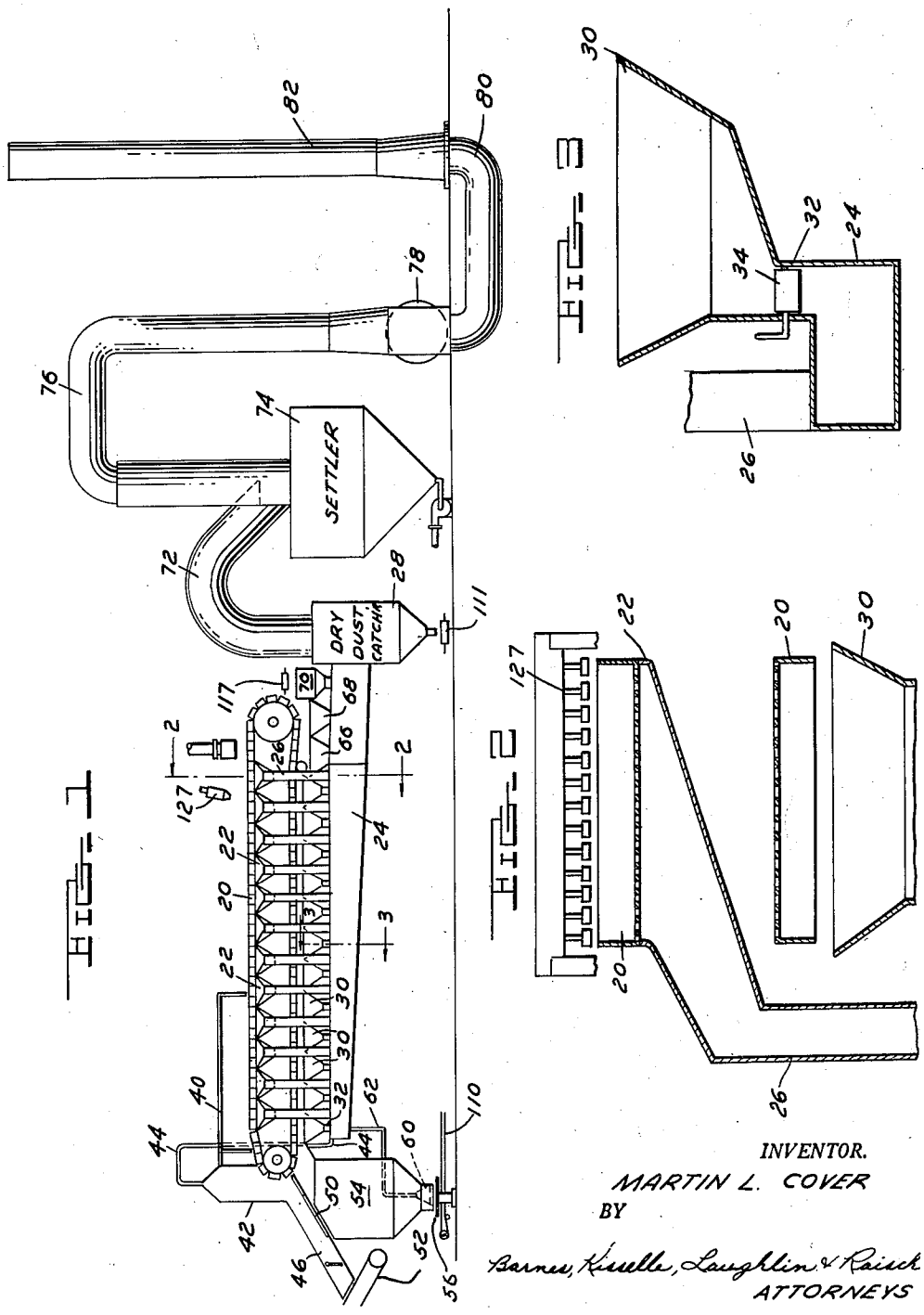


FIG. 1

FIG. 3

FIG. 2

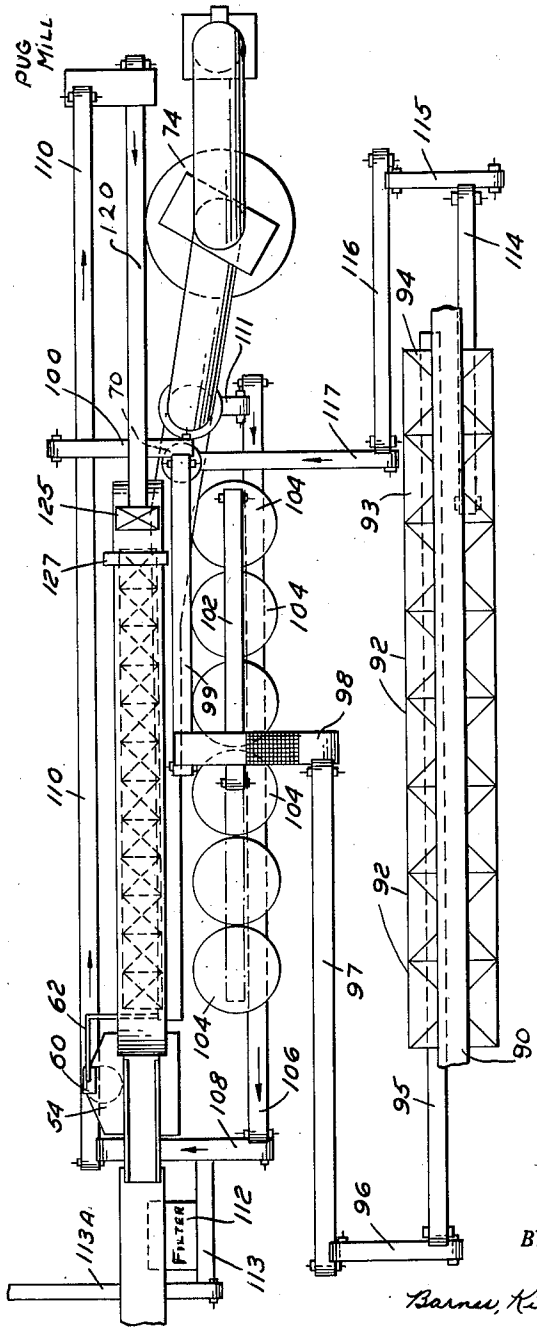
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FIG. 4



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FIG. 6

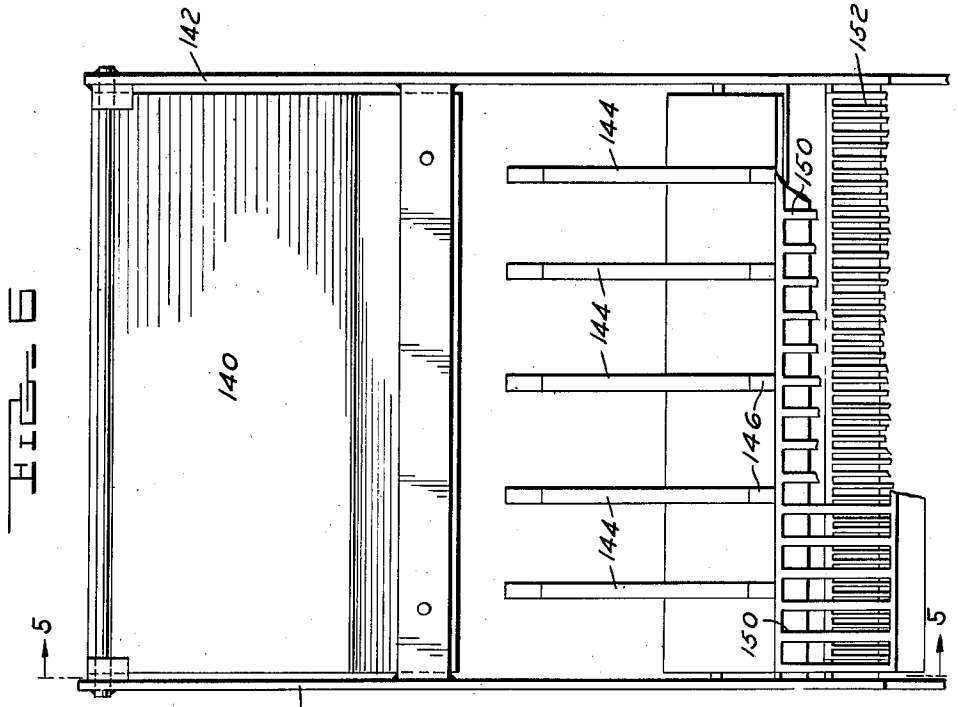
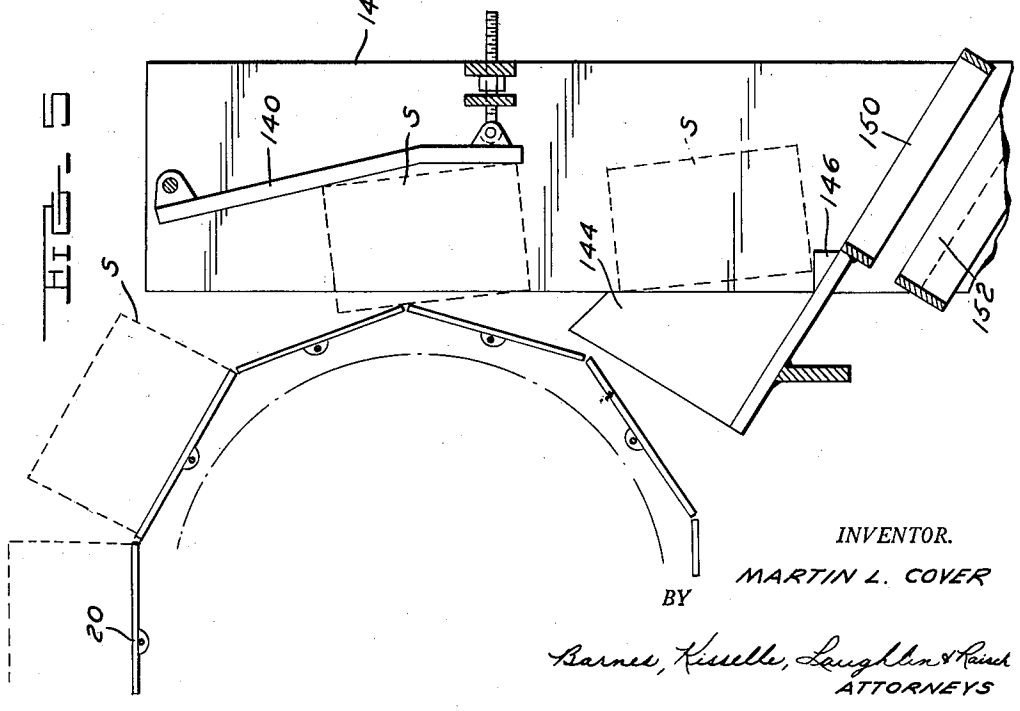


FIG. 5



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2,768,890

METHOD OF SINTERING

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Application April 27, 1951, Serial No. 223,375

2 Claims. (Cl. 75—5)

This invention relates to a method and apparatus for making sinter.

In blast furnace operation it is common to use material called sinter as a part of the furnace charge. One ingredient of sinter is finely divided ore, sometimes ground up in order to concentrate the valuable portion. Other ingredients include recovered flue dust, recovered fines, powdered coke and mill scale. This fine material cannot be fed directly to the furnace since it would blow out and reduce the efficiency of the furnace.

These ingredients, all in relatively fine condition, are mixed together with a suitable amount of moisture and distributed on moving beds called pallets. The top of the distributed mixture is ignited and air is pulled through the bed from top to bottom to stimulate the burning action and carry it through the material. This burning action tends to cake-up the material after which it is broken up into chunks 3" in diameter and larger, and fed to the stock pile for the blast furnace. It is important that the resulting sinter have a certain structural strength so that it will not slack-out or crush in the handling operations and in the blast furnace.

It is an object of the present invention to provide a sintering appatus which eliminates dust hoppers. Suction creating means, called wind boxes, draw air through the burning beds. Previously it has been necessary to provide hoppers to catch fines dropping from the bed or pallets. In the present apparatus an enclosed controlled wind passage will carry escaping fines to a dust catcher. A similar treatment at the loading and discharge end of the pallet lines carries all recovered dust and fine droppings to a collecting source where it is added to the flow of material to the sintering beds.

Another object of the invention is the introduction of a filter cake into the mix to retain moisture at the lower portion of the bed thus preventing the material from drying out before burning. In this connection fine ore such as Taconite and finely divided fuel are mixed into the recovery lines of the system and dispatched to a settler and thence to the filter from which the moist material issues to the required pug mill.

The objects in resumé are then the operation of a sintering apparatus with no dust outlets, a system in which fines are introduced to the system to mix with recovered fines, and emerge as filter cake, a thicker bed on the burning pallets with enough low placed moisture to prevent drying prior to burning, a better quality sinter, a greater quantity of sinter, an apparatus subject to accurate control for such production, and an apparatus for producing sinter in the proper size for use.

Drawings accompany the description to illustrate the apparatus and to assist in the disclosure of the steps of the method. The various views thereof may be described briefly as follows:

Fig. 1, a diagrammatic elevation of the sintering machine.

Fig. 2, a sectional view on line 2—2 of Fig. 1.

Fig. 3, a sectional view on line 3—3 of Fig. 1.

Fig. 4, a diagrammatic plan of the apparatus.

Fig. 5, a rear enlarged view of the discharge end of the sinter machine.

Fig. 6, an elevation of the discharge end of the sinter machine.

The sintering system to be described is a variation of that accomplished with a Dwight-Lloyd sintering machine. As shown in the drawings a series of driven pallets are illustrated diagrammatically at **20** moving in a closed circuit. In the usual sequence, these pallets in the upper traverse are loaded, fired, and dumped. The charge, in the present case, is related to the method of operation in which recoverable dust and fines are mixed with fine ore and fine fuel (breeze) and recovered in a settling tank. As sludge this material is sent to a filter and removed therefrom as moist filter cake. The filter cake plus the usual charge of flue dust, ore, scale, and fine coke is then sent to a plug mill and mixed before being loaded on the moving pallets.

A plurality of wind boxes **22**, in this case twelve, underlie the pallets each with a duct **26** leading down to a wind manifold **24** which extends below the sintering bed to a dry dust catcher **28**. The lower traverse of the pallets travels just above another series of supplemental wind collector boxes **30** each connected to the manifold **24** by a short duct **32** in which is mounted a control damper **34**. The bottom wall of the manifold **24** is sloped down toward the dry dust catcher about 10° to 15°.

At the dumping end of the sintering traverse is a hood **40** extending over an area equal to about the last 5 wind boxes. An end chute hood **42** tops an end chute **46** overlying the grizzlies **50** which are spaced bars upon which the dislodged sinter falls as it passes to a cooling conveyor **52**. An air pipe **44** connects the hood **42** to manifold **24** to create reduced pressure in the hood.

Below the grizzlies **50** is a hot fines bin **54** which receives hot fines from the grizzlies **50** and discharges it to a conveyor later to be described. A rotating table **56** removes the fines from the bin and deposits them on the belt.

A dust recovery cap **60** is positioned at the point of loading from the hot fines bin and connected by a conduit **62** to the end of manifold **24** to create a low pressure area in this locality where dust might develop.

At the loading end of the sintering machine, two hoppers **66** and **68** extend beyond the twelve wind boxes to collect falling particles and dust at this loading area. A damper control may be used to prevent excessive draft here. A third hopper **70** at the end of the manifold is positioned to receive fine ore and breeze (fine coke) from supply bins as will be later described.

The manifold **24** terminates in the dry dust catcher **28** which collects coarse material that will not carry up with the moving air. A large wind pipe **72** leads to a combined washer and settling tank **74** described in my Patent No. 2,539,992 issued January 30, 1951. Air is pulled through the tank **74** to a pipe **76** by a vacuum fan **78** capable of handling for the present disclosure about 108,000 cubic feet of air per minute and designed to produce vacuum to the extent of 24" to 30" of water. The outlet for the fan is a subsurface pipe **80** leading to a stack **82**. The air leaving the stack **82** is practically dust free.

In Fig. 4 is a diagrammatic plan layout of the system showing the manner in which the charge is mixed and loaded. A track **90** carries cars which dump into a plurality of bins **92, 93, 94**. The bins **92** contain the ordinary sinter forming materials such as flue dust, ore scale,

breeze (cake) etc. Bins 93 and 94 contain, respectively, fine ore and powdered fuel.

A conveyor 95, 96, 97 carries material from bins 92 to a screening unit 98 which removes the too coarse material to a conveyor 99, 100 which takes the material to the yard. Material of suitable size will pass through the screening unit to a shuttle conveyor 102 which fills bins 104 with sinter mix.

A conveyor 106 below bins 104 carries sinter material from the bins to a transverse conveyor 108 which in turn carries the material to a long ascending conveyor 110 leading to a pug mill. A short conveyor 111 deposits material from the dry dust catcher into the conveyor 106 at the beginning of its upper run toward the bins 104. Meanwhile sludge from the washer and settler has been pumped to a filter 112 from which it emerges on to a conveyor 113 which dumps the moist filter cake into csonveyor 108 leading to conveyor 110 and the pug mill. A diverting conveyor 113A can convey filter cake to the yard if excessive in quantity or if plant is down.

But bins 93 and 94 containing fine ore and powdered fuel are serviced by a separate conveyor 114, 115, 116, 117 which carry material from these bins to a hopper 70 at the end of manifold 24. Thus powdered ore and powdered fuel are introduced into the products of the washer 74 and filter 112 to provide a moist filter cake having about 26 to 30% moisture remaining. A feeder to control the amount of fines introduced into the air stream is provided with the hopper 70. A rotating cylinder with radial blades at the bottom opening will move the material out evenly. My copending application Serial No. 181,654 filed August 26, 1950, now abandoned, shows such a device.

From the pug mill the material is carried by a conveyor 120 to a swinging spout 125 where it is distributed to the pallets 20 as they start their upper traverse. This swinging spout is described in my Patent 2,422,470 issued June 17, 1947. Adjacent the swinging spout is an ignition device 127 as disclosed in my Patent No. 2,375,895 issued May 15, 1945.

If only one pug mill is used and no fluffers after the filter cake is introduced a large part of the filter cake will form balls which greatly aid in the sintering process.

On the Dwight Lloyd sintering machine the sinter mix is ignited on the top and air is pulled by vacuum down through the sinter bed. For maximum quantity and highest quality of sinter production the total sinter mix must contain around 9% to 12% moisture. It must contain the correct amount of carbon and the bed must be as porous as possible. In order to obtain these highest results a 28" H_2O vacuum and about 13" deep bed should be used. A higher vacuum and a deeper bed should give still better results but the hot products of combustion have a tendency to dry out the lower part of the bed. The 28" vacuum and the 13" bed, I have found, gives the optimum results with materials I use.

The balls of fine material formed from the filter cake contains a rather high amount of moisture. A rather large proportion of these balls will accumulate at the lower part of the bed and help to keep the moisture in the mix between the 9% and 12% limits, if the 28" vacuum and 13" bed are used.

When extra pug mills or fluffers are used they tend to break up these balls. The moisture is then not carried to the lower part of the bed and the fine materials cause the bed to tighten up and lose its porosity. This has a tendency to reduce both the quantity and the quality of the sinter made.

In a plant where belt scrapers, junction boxes, filter scrapers, filtrate removers, swinging spout, pug mill and belt speeds and widths are properly engineered the total mix may contain up to 50% of the 26% to 30% moisture filter cake and sinter of the very highest quality can be made.

The amount of this high moisture filter cake that can be used in this plant is limited only by the amount of moisture and carbon it contains that can be neutralized by the hot return fines. I use from 25% to 30% of the total mix from these returns, and have them at a bright red temperature. The temperature and amount of these returns are controlled by the use of "grizzly packs" that I have developed and which can be changed with little or no delay in the sintering operation.

The ordinary swinging spout will not handle the high percentage of very wet filter cake. I have developed a swinging spout as disclosed in my Patent No. 2,422,470 that keeps the sinter bed fluffy and porous, does not break up the "balls" of fine materials and does not require any hand pounding. It would easily handle 1800 tons of 26% to 30% moisture filter cake in 24 hours if the returns neutralize the moisture and carbon in it so that the total mix will contain the right percentage of moisture and carbon.

In this layout I use a table feeder for the very fine ore such as Taconite and one for the fuel so that they are mixed in the correct proportions. This mixture is then fed into the sloping wind main with just enough air leaking in to keep down the dust. Inside the main the wind thoroughly mixes the fine ore and the fuel.

In the usual layout, the fan is designed to handle 9,000 cu. ft. of air per minute per wind box. It is pretty well established that this is the correct amount of air to get best results.

In order to take care of the air that "leaks in" at the various points, I have increased the fan size so that it will handle over 10,000 cu. ft. of air per minute per wind box.

The following shows the unusual results that can be obtained with my layout for handling fine materials and my method of operation. On a 12 wind box machine the following results can be obtained in 24 hours operation.

	Percent Moisture Content	Net Tons
(a)		
Material:		
Blast furnace catcher dust	12	175
Blast furnace filter cake	30	250
Blast furnace ore	12	600
Taconite ore in filter cake	30	1,400
Sinter produced		1,630
Quality Excellent.		
(b)		
B. F. Catcher dust	12	800
B. F. Filter cake	30	1,700
B. F. Ore		00
Sinter produced		1,700
Quality of sinter excellent if carbon and moisture can be controlled by the return fines.		
(c)		
If dried out filter cake (10% moisture) is used:		
B. F. Catcher dust	12	500
B. F. washer dust	10	600
Sinter produced		850
Quality poor.		

The dry dust catcher 28 is of very simple design. No attempt is made to remove any of the very fine materials as they can be handled to a much better advantage in the filter cake. The sand blast action of air varies approximately in proportion to the square of the wind velocity. Eddy currents increase this wear and cause vacuum loss. For this reason too no whirling action and comparative low velocities of air are used in this dust catcher.

A combined washer and thickener 74 follows the dust catcher. The washer thoroughly cleans and drys the wind so that the life of the fan blades is indefinite and the surrounding air is not polluted with dust and fumes.

The thickener has no moving parts and does not take up an excessive amount of space.

The plant as thus layed out is free from the dust that

originates from the sinter. The surrounding air is also free from dust produced in the sinter plant.

About twice as much very fine material can be handled than is possible with the usual plant layout and design.

A strong sinter free from Fayolite and at a very high production rate is made possible.

Referring to the drawings, in Figs. 5 and 6 I have shown the discharge end of the sintering conveyor diagrammatically but in sufficient detail to disclose a method of turning the sinter cake as it falls from the endless conveyor system. The reason for this turning is that a certain amount of sinter must be returned as hot fines to the sinter mix. It is best to return that part of the sinter cake which has the least structural strength and the most potential with relation to the dust making characteristics.

Now when the cake is dumped off right side up the fines on the top and the weakest material goes to the sinter stock yard. I propose to turn the cake as it falls so the top side hits the grizzly bars. Thus most of the fines will drop through the grizzlies and go into the hot fines bin. Also since returns larger than ¾" are detrimental, they can be screened out. Previously it was necessary to use larger returns to get enough. With the present system enough hot fines of ¾" and smaller are obtainable to avoid use of the larger returns. Another advantage of this turning operation is that the hot sinter lands on top where it will cool more readily as it passes to the stock yard.

In Fig. 5 a block of sinter S usually leaves the pallet at 30 to 45°. I provide a plate **140** between walls **141** and **142** to guide the sinter cake downward. This plate **140** is adjustable to different thicknesses of cake.

Guide bars **144** direct the cake almost straight down where a corner strikes steps or bumper blocks **146** which catch the cake and cause it to turn over before it hits the grizzlies **150**. With this arrangement grizzlies **150** with 3" spacing may be used to remove large chunks and a lower set of grizzlies **152** with ½" or slight larger spacing may be used to permit only fine materials to pass into the hot fines bin.

What I claim is:

1. A method in connection with the use of a sintering apparatus which comprises collecting dust and recoverable particles from all parts of said machine in a moving stream of air, introducing into said stream a measured quantity of fine ore and fine fuel, removing coarse particles from said stream in dry condition, washing the remaining particles from said stream with water, removing the water from said recovered particles to leave a material containing 26 to 30% moisture, and introducing said moist material into a sinter bed adjacent the lower portion thereof in balled dispersed condition.

2. A method in connection with the use of a sintering apparatus which comprises moving pallets in a continuous motion in loaded and unloaded condition, drawing air into a moving stream from loaded pallets, empty pallets, and from the loading end and discharge end of said machine, introducing into said stream a measured quantity of fine ore and fine fuel, washing the collected particles from said stream with water, removing the water from said collected particles to leave a material containing 26 to 30% moisture, and introducing said moist material into a sinter bed adjacent the lower portion thereof in balled dispersed condition.

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