# United States Patent [19]

**Torrence**

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[54] **HIGH TEMPERATURE SCRAP CLEANING CONVEYOR**


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[73] Assignee: **American Pulverizer Company**, St. Louis, Mo.



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[52] **U.S. Cl.** ..... **432/72**, 432/266, 198/218, 34/185, 110/18 R

[51] **Int. Cl.** ..... **B65g 21/00**

[58] **Field of Search** ..... 263/21, 6; 34/242, 34/185; 266/15; 110/18 R, 8 A; 432/266, 11, 73; 198/218, 191, 204, 10



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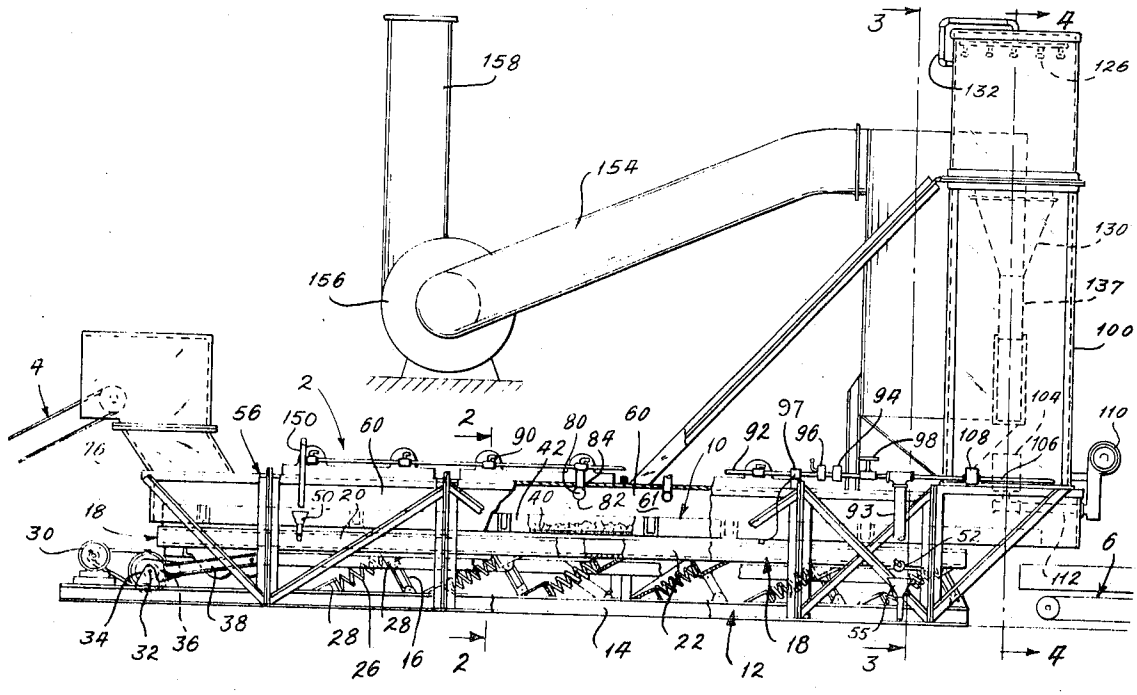
[57] **ABSTRACT**

A high temperature scrap cleaning conveyor includes a conveyor comprised of a conveying deck, a mechanism for oscillating the deck, and a water-filled pan beneath the deck. Shredded scrap metal contaminated primarily with paint, oil and grease is deposited on one end of the conveying deck and the oscillating motion of the deck causes the scrap to move toward the deck's opposite end, tumbling and turning as it does. Water is circulated through the pan and this water not only insulates the oscillating mechanism from the heated conveying deck, but it also cools the conveying deck, since the oscillations cause the water to splash against the underside of the deck. A framework supports an insulated closure which extends over and along the sides of the conveying deck, and this closure defines a fire chamber in which a series of transversely extending burners are located. The burners produce downwardly directed flames which not only raise the temperature of air within the fire chamber, but also impinge on the scrap carried on the conveying deck and burn the contaminants from the scrap. Since the scrap tumbles as it advances, all surfaces thereof are presented toward the flame. An airstream is created within the fire chamber by a fan, and the air for this airstream is derived from air gaps existing between the sides of the conveying deck and side curtains which form the sides of the insulated closure. These side curtains may be adjusted inwardly and outwardly to control the size of the air gaps and this in turn controls the air velocity through the fire chamber. The curtains may be removed altogether to gain access to the burners and conveying deck. At the discharge end of the oscillating conveyor the airstream enters a smoke elimination tower having a high velocity burner at its entrance for raising the temperature of the airstream sufficiently to consume smoke, fumes, and most entrained material. The smoke elimination tower is connected with a cooling chamber where a high pressure water mist is sprayed into the airstream for cooling the airstream and for removing the larger particulates therefrom. Downstream from the cooling chamber, the airstream flows through a plate-type impingement scrubber where more particulates are removed, and thence into a cyclone collector where the airstream loses velocity and the remaining particulates drop out. The drain water from the cooling chamber and scrubber flows into the cyclone collector where it flushes the particulates dropped therein. The water discharges from the collector into a settling tank for clarification and is recycled by a pump through the water pan of the oscillating conveyor. Only fresh water is supplied to the nozzles of the cooling chamber and to the scrubber. The fan is located downstream from the cyclone colector and discharges the airstream into the atmosphere in a purified condition. The foregoing units are interlocked and no one unit is operated independently.


**12 Claims, 8 Drawing Figures**

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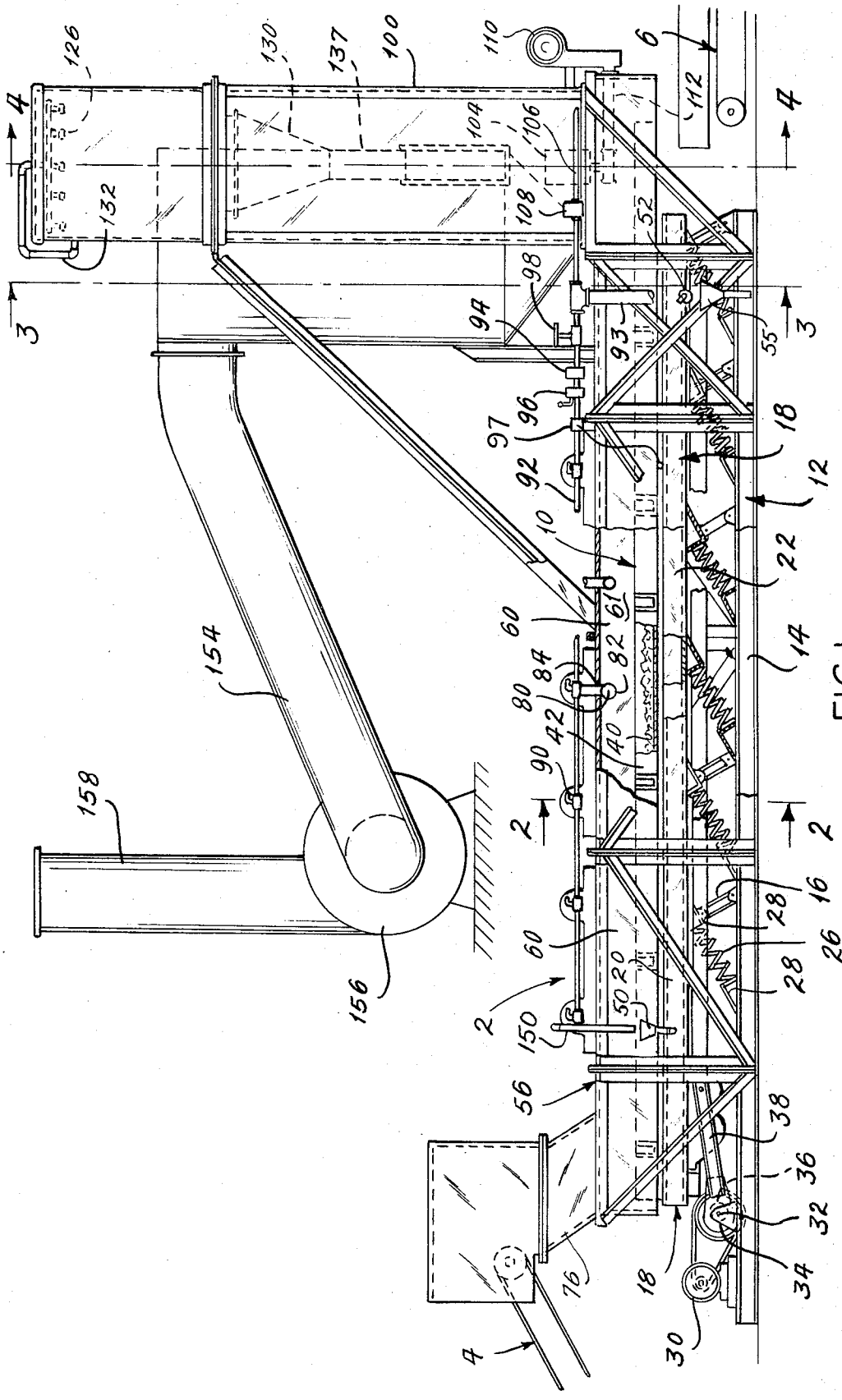

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FIG. 1

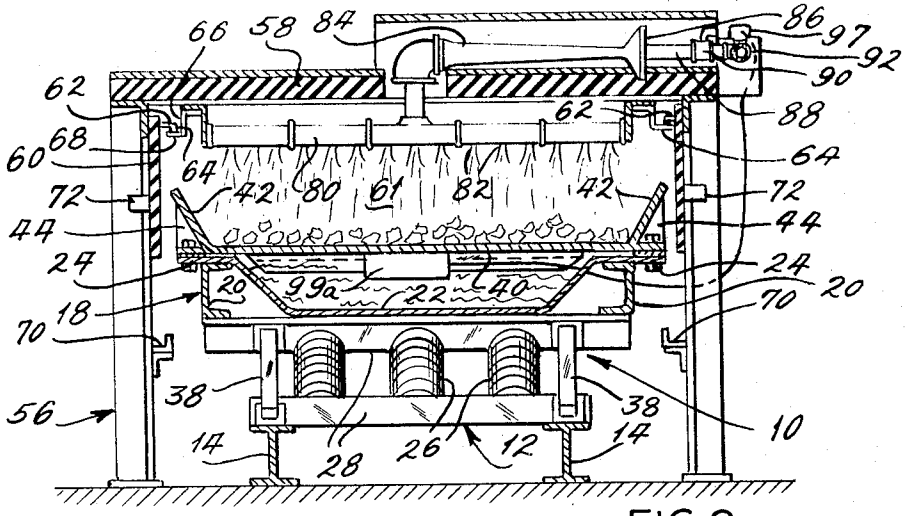



FIG. 2

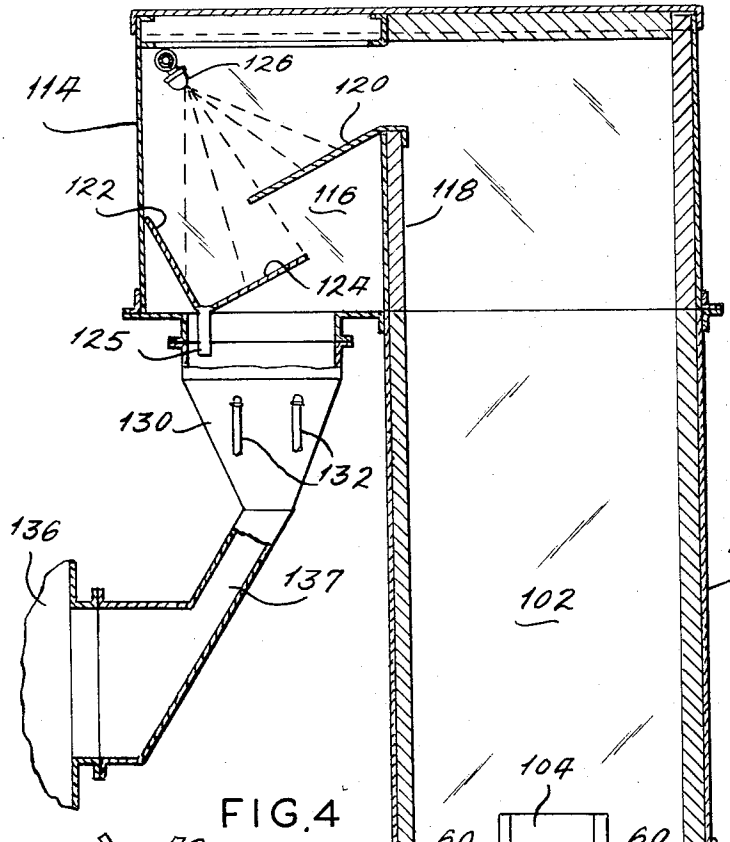



FIG. 4

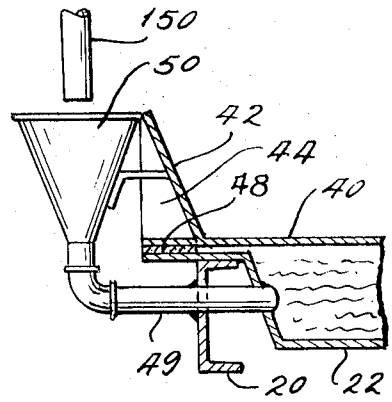



FIG. 6

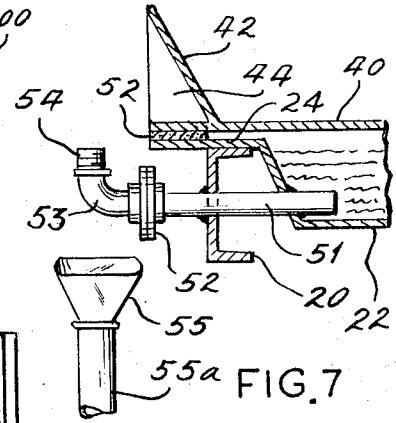



FIG. 7

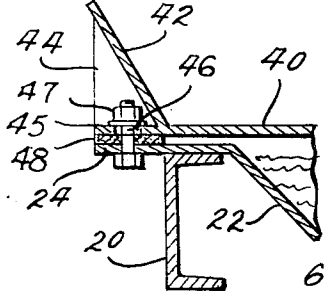



FIG. 5

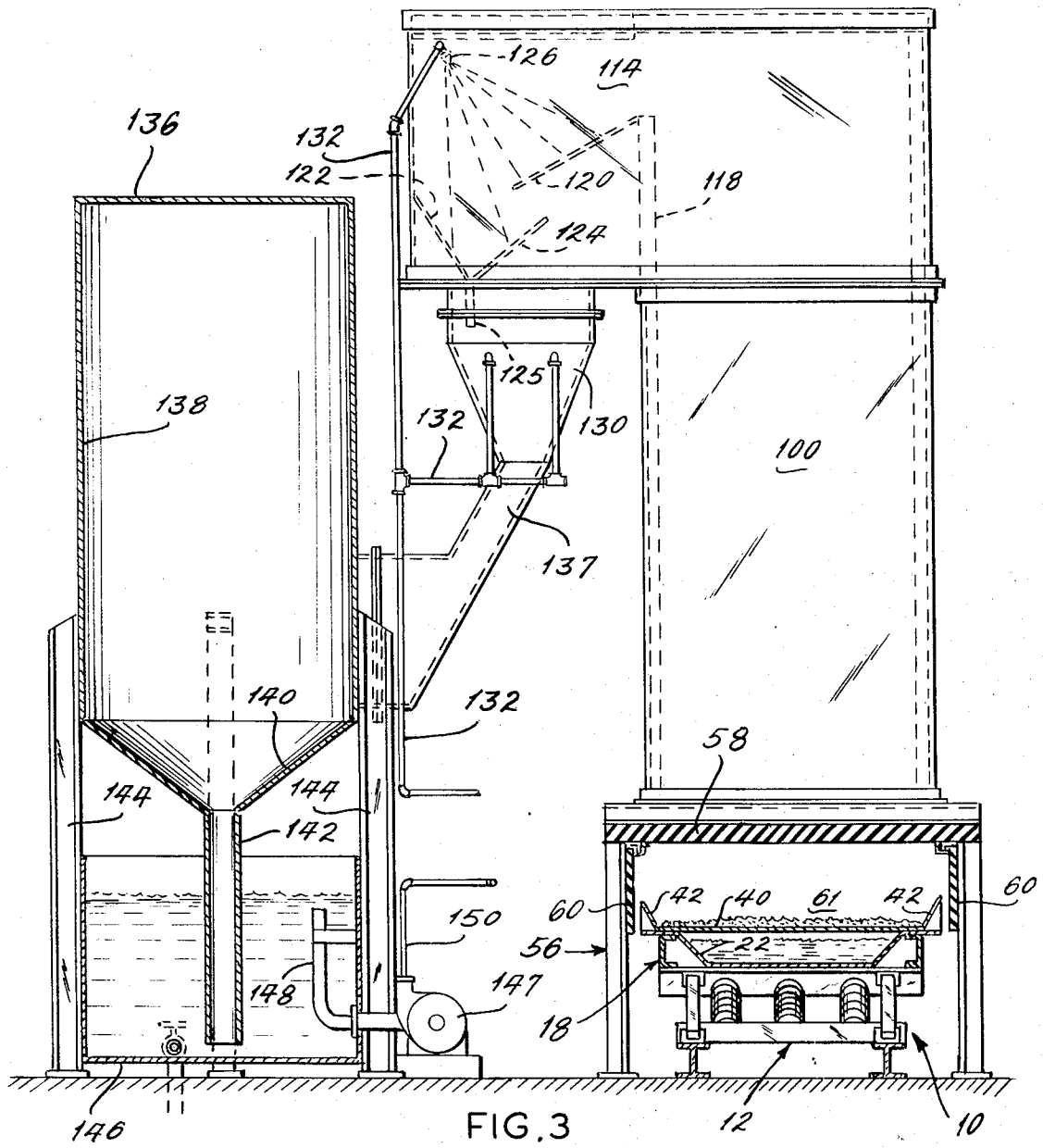

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FIG. 3

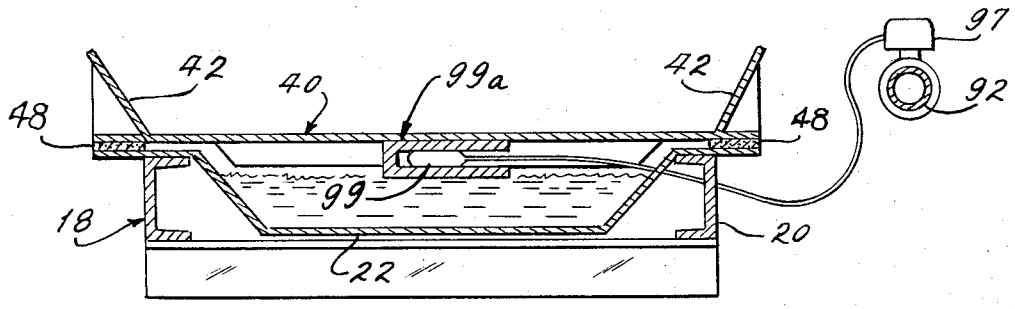

97
42
40
99a
42
92
48
48
99
18
20
22

FIG. 8

# HIGH TEMPERATURE SCRAP CLEANING CONVEYOR

## BACKGROUND OF THE INVENTION

This invention relates in general to an apparatus and process for cleaning shredded metal and, more particularly, to a high temperature cleaning conveyor and process.

Large quantities of scrap still are consumed in the steel industry for conversion into basic steel products, and this scrap steel is to a large measure purchased from independent scrap dealers. In order to avoid contamination and a resulting inferior grade of steel, the scrap steel utilized in current steel making processes must be relatively clean. Consequently, steel mills prefer and indeed pay a premium price for scrap which is physically clean, that is, scrap which is free from and not intermixed with non-ferrous metal impurities and non-metallic particles, and is also free of grease, oil and paint.

Junked automobiles provide one of the largest sources of scrap steel and similarly discarded appliances such as stoves, refrigerators, hot water heaters and the like and constitute a significant source. The steel in these products usually possess a coating of paint and furthermore is often covered with grease and oil. Moreover, these products contain a significant amount of non-metallic substances such as glass, plastic, rubber, and upholstery material, and limited quantities of non-ferrous metals are also present, usually in the form of small electrical wires and aluminum. Consequently, junked automobiles without additional processing are of little value to the basic steel industry.

Heretofore junked automobiles and appliances have been stripped of valuable non-ferrous metals and glass and the remaining hulks have been burned in open fires to free the steel in those hulks of paint, grease, oil and those non-metallic substances which will burn. Thereafter, the relatively clean hulks were shredded and the shredded steel scrap sold to steel mills. This procedure was time consuming and required much manual labor. Furthermore, it left many contaminants with the steel. In any event, the foregoing process is no longer available, for the Federal government has prohibited burning automobile bodies in open fires because of the severe air pollution created by such burning.

Currently, junked automobiles and appliances are shredded and the reduced material is run through a magnetic separator to separate the steel therefrom. The steel so separated is then passed through large rotor-type kilns or incinerators which are connected with cooling equipment, smoke incinerators and other anti-pollution devices. Equipment of the foregoing nature is exceedingly large in size, extremely complex and expensive, and requires extensive foundation work. It furthermore consumes large amounts of electrical energy and requires constant maintenance, which due to its complex nature can only be conducted by highly skilled personnel. Accordingly, equipment of the foregoing nature requires large plant facilities and is well beyond the financial capabilities of all but the largest dealers in scrap. Clearly, such equipment cannot be operated at a profit where the plant output ranges between 20 to 30 tons per hour.

## SUMMARY OF THE INVENTION

One of the principal objects of the present invention



is to provide an apparatus and process for burning oil, grease, paint and the like from shredded steel scrap. Another object is to provide an apparatus and process of the type stated which reduces upholstery material, sound deadening material, small particles of copper wires, insulation and the like which may adhere to or be intermixed with the steel scrap to vapor or ashes. A further object is to provide an apparatus of the type stated which is highly compact and does not require large plant facilities or extensive foundation work. Another object is to provide an apparatus of the type stated which can be used in existing scrap processing yards without extensive remodeling or rearrangement of equipment. An additional object is to provide an apparatus of the type stated which is simple in construction and does not require much maintenance. Still another object is to provide a process and apparatus of the type stated which requires a minimal amount of energy. Yet another object is to provide a process and an apparatus which will make it economically possible for small and moderately sized dealers in scrap to process steel scrap for sale to steel mills. These and other objects and advantages will become apparent hereinafter.

The present invention is embodied in a high temperature scrap cleaning apparatus including a conveyor for tumbling the scrap while contaminants are burned from it. The invention also includes fan means for creating an airstream over the scrap and antipollution means for cleansing the airstream before it is discharged into the atmosphere. The invention also consists in the parts and in the arrangements and combinations of parts hereinafter described and claimed.

## DESCRIPTION OF THE DRAWINGS

In the accompanying drawings which form part of the specification and wherein like numerals and letters refer to like parts whenever they occur:

FIG. 1 is a side elevational view of a high temperature scrap cleaning conveyor constructed in accordance with and embodying the present invention;

FIGS. 2, 3 and 4 are sectional views taken along lines 2—2, 3—3 and 4—4 respectively of FIG. 1;

FIG. 5 is an enlarged sectional view of an expansion-type bracket for securing the agitating scrap conveying deck to its supporting frame;

FIG. 6 is a fragmentary sectional view showing the water inlet to the pan of the oscillating conveyor;

FIG. 7 is a fragmentary sectional view showing the water outlet on the pan of the oscillating conveyor; and

FIG. 8 is a sectional view showing a thermocouple attached to the underside of the conveying deck of the oscillating conveyor for controlling the temperature in the fire chamber above the deck.

## DETAILED DESCRIPTION

Referring now in detail to the drawings, 2 designates a high temperature scrap cleaning conveyor which at one end receives shredded steel scrap from a product feed conveyor 4 (FIG. 1) and at its opposite end discharges the shredded scrap in a physically clean condition onto a product removal conveyor 6. The scrap delivered to the cleaning conveyor 2 by the feed conveyor 4 is derived from old automobile hulks, home appliances, and the like which, after a minimal amount of stripping to remove valuable products and metal therefrom, have been shredded to reduce them to a more compact form. The shredded material is then run

through a magnetic separator to separate the steel and non-ferrous particles. Despite the magnetic separation, non-metallic substances such as upholstery, sound deadening material, small electrical wires, insulation, adhere to or remain embedded in the shredded steel. Moreover, much of the shredded steel has at least some paint adhering to it as well as a heavy coating of grease and oil.

The high temperature conveyor **2** contains an oscillating conveyor **10** which constitutes the assembly for transporting shredded scrap from the feed conveyor **4** to the removal conveyor **6** and for supporting that scrap while it is cleaned. The oscillating conveyor **10** includes (FIGS. **1** and **2**) a fixed base **12** which is set upon the ground and has a pair of longitudinal members **14** to which the lower ends of upstanding support bars **16** are connected such that they pivot or swing relative to the members **14** about axes perpendicular to the members **14.** At their upper ends the support bars **16** are connected to an oscillating frame **18** such that they pivot in a like manner relative to that frame. The bars **16** are furthermore disposed obliquely to the base **12** and frame **18** and extend rearwardly from the former to the latter. The frame **18** at its sides has a pair of longitudinal channel members **20** and welded to the uppermost flanges on the channel members **20** is a water pan **22** which bridges the members **20** and is depressed considerably between them. The water pan **22** furthermore has lateral extensions **24** which project horizontally beyond the sides of the members **20** at both ends of its depressed portion to retain a pool of water therein.

In addition to the pivotally connected support bars **16** the oscillating frame **18** is further supported by a series of coil springs **26** which likewise extend between the base **12** and the supported frame **18** and abut against angled spring seats **28** on the base **12** and frame **18.** The springs **26** are oriented with their axes generally perpendicular to the support bars **16.**

At the infeed end of the oscillating conveyor **2**, the fixed base **12** supports a variable speed drive motor **30** (FIG. **1**) which rotates a conveyor drive shaft **32** journaled in pillow blocks **34** on the base **12.** Fixed to the drive shaft **32** are a pair of eccentrics **36** which are confined in the ends connecting rods **38** such that they rotated relative to the connecting rods **38** and impart a longitudinal shifting movement of an oscillatory nature thereto. The opposite ends of the connecting rods **38** are also attached to the oscillating frame **18** so that the oscillatory movement is also imparted to the frame **18.**

The oscillating frame **18** carries a conveying deck **40** (FIG. **2**) which bridges the depressed portion of the water pan **22** and has upwardly and outwardly turned containing walls **42** along its sides. The containing walls **42** are disposed directly above the lateral extensions **24** of the pan **22** and at spaced intervals are provided with supporting brackets **44** (FIG. **5**) having horizontal flanges **45** at their lower ends. These flanges **45** have slots **46** which extend perpendicular to the longitudinal axes of the conveying deck **40.** The slots **46** receive bolts **47** which further extend through the lateral extensions **24** of the pan **22** and secure the conveying deck **40** to the frame **18.** Interposed between the lateral extensions **24** and the overlying flanges **46** are asbestos slip pads **48,** through which the bolts **47** extend also. Since the slots **46** are elongated transversely of the conveying deck **40,** they permit the conveying deck **40** to expand laterally of the water pan **22** and frame **18** without buckling. Thus, the conveying deck **40** will retain its proper configuration even when its temperature is considerably higher than the temperature of the pan **22** and the frame **18.** The conveying deck **40** extends beyond the terminal end of the frame **18,** and this longitudinal projection of the deck **40** is disposed above the end of the product removal conveyor **6.**

When the conveyor drive motor **30** is energized the frame **18** will experience an oscillating movement and this movement wll be transmitted to the conveying deck **40.** Consequently, shredded scrap on the deck **40** will agitate in the vertical direction and will be advanced toward the removal conveyor **6.** Since the movement is effected by vertical agitation, the scrap will tend to tumble or otherwise turn and change position on the deck **40** as it is advanced.

At its one end the water pan **22** is provided with an inlet pipe (FIG. **6**) **49** which projects outwardly from the depressed portion thereof and extends through the adjacent channel member **20** of the frame **18.** Beyond the channel member **20,** the pipe **49** turns upwardly and terminates at an upwardly opening funnel **50.** At its opposite end, the water pan **22** is provided with an outlet pipe **51** (FIG. **7**) which also projects from the depressed portion thereof through the adjacent channel member **20.** The outer end of the pipe **51** is fitted with a swivel connector **52** to which an elbow **53** is connected, and the elbow **53** carries a short pipe nipple **54.** The angular disposition of the elbow **53** determines the height of the free end of the nipple **54,** and that height is the same as the water level in the pan **22.** Thus, the elbow **53** controls the level of the water in the pan **22.** The pipe nipple **54** is located over a funnel **55** on the end of a drain pipe **55***a* leading to a sewer.

The oscillating conveyor **10** extends through a tunnel-like framework **56** (FIGS. **1** and **2**) which carries a thick overlying insulation blanket **58** and a series side curtain **60.** The insulation blanket **58** extends completely across the top of the oscillating conveyor **10** and the framework **56** as well, and has a metallic cladding. The side curtains **60** (FIG. **2**) also carry heat insulative material and depend downwardly from the insulation blanket **60,** extending completely across the sides of the conveying deck **40.** Thus, the blanket **58** and curtains **60** in combination form an insulated closure over the conveying deck **40,** and this insulated closure defines a fire chamber **61,** the base of which is the conveying deck **40.**

Each side curtain **60** at its upper end has a series of inwardly turned flanges (FIG. **2**) which have downwardly turned inner lips **64.** The tunnel-like framework **56** on the other hand carries downwardly extending supporting brackets **66** which, generally speaking, are located directly above the upper edges of the confining walls **42** on the conveying deck **40.** The brackets **64** have upwardly opening channels **68** at their lower ends, and these channels **66** receive the downwardly turned inner lips **64** of the flanges **62** on the curtains **60** so that the curtains **60** are suspended from the brackets **64.** The channels **68** are considerably wider than the downwardly turned lips **64** so that the curtains **60** may be shifted inwardly and outwardly. This, in turn, permits adjustment of the air gap between the inner face of each side curtain **60** and the upper edge of the containing wall **42** located opposite to that curtain **60.**

The flanges 62 may be disengaged from the brackets 66 by lifting the side curtains 60 upwardly and then pulling them outwardly so that the lips 64 of the flanges 62 pass beyond the channels 68 of the brackets 66. Thereupon, the curtains 60 may be lowered to gain access to the conveying surface of the conveying deck 40. This enables the operator to remove or dislodge oversize objects which impede movement of the scrap along the oscillating conveying deck 40. In order to support the side curtains 60 while they are removed from their normal positions, temporary support brackets 70 are attached to the sides of the framework 56. Also, to facilitate removal and replacement of the side curtains 60, they are provided with handles 72.

Above the feed end of the oscillating conveyor 10 the framework 56 supports a feed chute 76 (FIG. 1) which is disposed below the discharge end of the feed conveyor 4. The feed chute 76 channels the scrap discharged by the feed conveyor 4 onto the conveying deck 40 of the oscillating conveyor 10.

The tunnel-like framework 56 further supports a series of burners 80 (FIG. 2), and these burners are housed within the insulated fire chamber 61 formed by the insulation blanket 58 and the side curtains 60. In particular, each burner 80 is supported at its ends from the framework 56 so that it is disposed above the conveying deck 40 and scrap thereon, and is oriented such that it extends transversely across the conveying deck 40. Spaced longitudinally along each burner 80 are flame orifices 82 which open downwardly, that is toward the conveyor deck 40. Each burner 80 at its center is connected to a header 84 which extends upwardly through the insulation blanket 58 and then turns laterally toward one side of the framework 56. The header 84 terminates at an aspirator 86 and projecting into the aspirator 86 is a gas supply pipe 88 having a shutoff cock 90 therein. Beyond the shutoff cocks 90 the supply pipes 88 of the several burners 80 are connected to a common gas supply line 92 which leads to a gas main 93 containing a combustible gas. Prior to the supply pipe 88 leading to the first burner 80, the gas supply line 92 has a line pressure safety valve 94, a gas pilot safety valve 96 provided with a manual reset, a modulating valve 97, and a line pressure regulator 98. The modulating valve 97 is connected to and operated by a thermocouple 99 (FIG. 8) which is housed within a thermocouple well 99a attached to the underside of the conveying deck 40.

Combustible gas from the supply line 92 enters the supply pipes 88 from which it is injected into the headers 84 at the aspirators 86 therein. The gas flowing into the headers 84 causes air to be drawn into the headers 84 at the aspirators 86 also and in sufficient quantities to support combustion of the gas. The air and gas are thoroughly mixed by the time they reach the burners 80 and this combustible mixture issues from orifices 82 in the burners 80 as high velocity jets. When ignited these jets produce downwardly directed flames which impinge upon the scrap supported by the conveying deck 40. Additional air is supplied to the fire chamber 61 through the air gaps existing between the containing walls 42 on the conveyor deck 40 and the inside faces of the side curtains 60. If this does not support combustion, thermocouples built into the burners 80 will shut off the gas supply.

As will be described in greater detail, a fan creates an airstream within the fire chamber 61 and the air for this airstream is derived primarily from the air gaps between the conveyor decks 40 and the side curtains 60. Since the side curtain 60 may be moved inwardly and outwardly, the size of the air gaps and the quantity of air drawn through them may be adjusted.

At the terminal end of the oscillating conveyor 10, that is at the end which discharges onto the removal conveyor 6, the tunnel-like framework 56 carries an air cleansing stack 100 (FIG. 4) which defines a smoke elimination chamber 102 in which the airstream also exists. Within the lower end of the chamber 102 the stack 100 supports a high velocity and high pressure burner 104 which is connected to the gas main 93 through a supply line 106 having a line pressure safety valve 108 in it. Combustion air for the burner 104 is derived from a centrifugal blower 110 mounted on the exterior of the stack 100 and connected to the burner 104 through an air duct 112 (FIG. 1). The burner 104 heats the airstream as it passes from the fire chamber 61 into the smoke elimination chamber 102 and this heating removes smoke from the airstream. Thus, the burner 104 and smoke elimination chamber 102 constitute a smoke incinerator.

At its upper end the cleaning stack 100 has a lateral offset 114 which defines a cooling chamber 116 (FIG. 4) located immediately beyond the smoke elimination chamber 102. The lower ends of the chambers 102 and 116 are separated from one another by a partition member 118 contained within the stack 100, but the upper ends of the two chambers 102 and 116 open into each other so that the airstream upon leaving the smoke elimination chamber 102 enters the cooling chamber 116. Within the cooling chamber 116, the offset portion 114 of the stack 100 mounts several baffle plates 120, 122 and 124 which are arranged to create a sepentine path through the cooling chamber 116. In particular, the baffle plate 120 extends obliquely downwardly from the upper end of the partition member 118, while the baffle plate 122 is disposed beyond the lower free end of the plate 120 and is generally perpendicular thereto. The baffle plate 124, on the other hand, extends obliquely upwardly from the lower edge of the plate 122 and is parallel to the plate 120, but is spaced downwardly therefrom. At the trough-like juncture of the plates 122 and 124, a drain tube 125 is provided so that water and particulates do not collect in that trough-like juncture. Near the upper outside corner of the cooling chamber 116, nozzles 126 are mounted on the offset portion 114 of the stack 100, and these nozzles 126 are set to direct a spray of fresh water onto the upwardly presented surfaces of all of the oblique baffle plates 120, 122, and 124. The water sprayed from the nozzles 126 is in the form of a high pressure mist. That mist cools the airstream passing through the cooling chamber 116 and further removes minute particulates from the airstream. It also moistens the baffle plates 120, 122 and 124 so that the particulates in the airstream adhere to these moistened plates as the airstream blows against them.

Attached to the bottom of the lateral offset portion 114 is a slot-type air scrubber 130 (FIGS. 3 and 4) through which the airstream passes after leaving the cooling chamber 116. The scrubber 130 is conventional in construction and can be purchased as a unit. It contains wet plates and counterflow water sprays. The impingement of the airstream on the wet plates and its passage through the counterflow sprays removes

practically all of the remaining particulates entrained in the airstream.

Both the nozzles **126** and the air scrubber **130** are supplied with water from a water line **132** which is connected to a high pressure supply of fresh water.

The discharge end of the air scrubber **130** is connected to a duct **137** which directs both the airstream and water discharged from the scrubber **130** to a cyclone-type collector **136** (FIG. 3). In particular, the collector **136** is closed and includes a cylindrical side wall **138** and a conical bottom wall **140.** The duct **137** connects tangentially with the side of the cylindrical side wall **138** and is oriented such that the airstream discharged therefrom initially flows tangentially with respect to the inside surface of the side wall **138.** The enlarged volume of the collector **136** causes the airstream to lose velocity, and this coupled with the cyclonic flow causes the remaining entrained particulates to drop out and further drop from the air and fall onto the conical bottom wall **140.** The conical bottom wall **140** has a downwardly extending discharge tube **142** connected to the center or lowermost portion thereof. Accordingly, the particulates lost in the cyclone collector **136** are flushed into the discharge tube **142.**

The discharge tube **142** leading from the lower end of the cyclone collector **136** extends into and terminates within a settling tank **146** (FIG. 3), and a water pump **147** is connected with the tank **146** through a stand pipe **148** which terminates close to the upper surface of the water in the tank **146.** Before the water enters the pump **147,** it passes through a filter to remove any particulates therefrom. The discharge port of the pump **147** is connected to a supply line **150** which leads to the funnel **50** on the inlet pipe **49** for the water pan **22,** so the water in the pan **22** is derived from the tank **146.**

Finally, the upper end of the cyclone collector **136** is connected to a duct **154** (FIG. 1) which leads to a fan **156.** The fan **156** in turn discharges into the atmosphere through a discharge stack **158.** The fan **156** creates the airstream previously discussed.

## OPERATION

Prior to introducing scrap into the high temperature cleaning conveyor **2** for removal of contaminants therefrom, the fan **156** is energized and this creates an airstream which traced backwardly from the fan **156** flows through the duct **154,** the cyclone collector **136,** the duct **147,** the air scrubber **130,** the cooling chamber **116,** the smoke elimination chamber **102** and the fire chamber **61.** Indeed, the airstream generated by fan **156** creates an air flow along the upper surface of the conveying deck **40** for the oscillating conveyor **10,** that is within the fire chamber **61,** and that air flow is the same direction as the conveyor **10** advances this scrap.

Once the airstream along the upper surface of the conveying deck **40** is initiated, the valve **94** is opened to allow combustible gas from the gas main **93** to flow through the gas supply line **92.** This gas enters the supply pipes **88,** and as it is injected into the headers **84** it draws air through the aspirators **86** so that the gas flowing through the headers **84** is mixed with air. This mixture of gas and air flows into the burners **80** and is discharged therefrom through the orifices **82** as relatively high velocity jets. These jets are ignited by a pilot flame or any other conventional burner lighting device and are consequently converted into flames which extend downwardly and impinge on the upper surface of the conveying deck **40.** Should the aspirators **86** fail to supply sufficient air to support combustion of the combustible gas introduced into the headers **84,** additional air is supplied by the air flow passing along the conveying deck **40,** and that additional air is derived from the air gaps existing between the sides of the conveying deck **40** and the side curtain **60.** Since the side curtains **60** are movable inwardly and outwardly, the size of those air gaps and the amount of air derived from them may be controlled. In any event, sufficient air exists to support combustion of the combustible gas within the fire chamber **61,** and this combustion is regulated at the valve **94** or by the modulating valve **97** to maintain the temperature in the fire chamber **61** at between 600°F. and 900°F.

In addition, the centrifugal blower **110** is energized and the gas valve **108** is opened so as to supply combustion air and combustible gas to the high velocity and high pressure burner **104** located in the base of air cleaning stack **100.** This elevates the temperature of the airstream flowing through the chamber **102.**

Also, the water pump **147** is energized and that pump draws water from the settling tank **146** and discharges it into the water pan **22** through the funnel **50** and inlet pipe **49.** By rotating the elbow **53,** the level of the water in the pan **22** is adjusted, and that level is such that when the frame **18** of the conveyor **10** oscillates, the water from the pan **22** will splash against the underside of the conveyor deck **40.** Thus, the water pan **22** serves two purposes. First, it cools the conveyor deck **40** and prevents it from warping under the intense heat from the burners **84,** and second it insulates the frame **18** and lower portions of the conveyor **10** from the heat of the fire chamber **61.**

The high pressure water in the line **132,** which is fresh water, is discharged therefrom through the nozzle **126** and the slot-type air scrubber **130.** This water leaves the nozzles **126** as a high pressure mist which passes through the high temperature airstream in the cooling chamber **116** and cools and cleans the same. The spray also impinges against the baffles **120, 122** and **124** enabling particulates to adhere thereto, and thereafter leaves the cooling chamber **116** by way of the drain tube **125** which discharges into the air scrubber **130.** The water supplied to the air scrubber **130** is converted into a counterflow sprays and further moistens plates therein. In any event, the water discharged through the nozzles **126** and into the scrubber **130** eventually cascades through the duct **137** and into the cyclone collector **136** where it flows across the conical bottom wall **140** thereof and enters the settling tank **146** for introduction into the water pan **22.**

Once the temperature within the fire chamber **61** above the oscillating conveyor **10** reaches the desired valves, which is usually between 600°F and 900°F, the product fed conveyor **4,** the oscillating conveyor **10,** and the removal conveyor **6** should all be energized if they are not already in operation. Shredded steel scrap is then allowed to flow along the feed conveyor **4** toward the feed chute **76** of the high temperature conveyor **2.** This scrap constitutes steel shreddings which may be derived from shredded automobile hulks, home appliances, and the like. Much of it possesses a coating of paint, and may further be covered with upholstery fibers, grease and oil. Before being introduced into the

feed conveyor 4 the shredded scrap should be run through a magnetic separator to eliminate non-ferrous metals and other non-ferrous substances therefrom. Notwithstanding the magnetic separation, the scrap may have non-ferrous metals such as small copper wires or aluminum embedded in it, and the same is true of other non-ferrous substances such as sound deadening material, plastic, glass and the like. Also the paint and grease and oil remain adhered to the scrap. Thus, the shredded scrap on the feed conveyor 4 is not physically clean from a metallurgical standpoint and will not be accepted by steel mills for conversion into basic steel products.

The feed conveyor 4 discharges the contaminated scrap into the feed chute 76 (FIG. 1) of the high temperature cleaning conveyor 2, and the feed chute 76 directs the scrap onto the feed end of the oscillating conveyor 10, or more particularly onto the conveying deck 40. The springs 26 and support bars 16 which carry the frame 18 on which the conveying deck 40 is mounted and the eccentric 36 and connecting rods 38 are all arranged such that the oscillatory motion imparted to the conveying deck 40 advances the scrap along the conveying deck 40 toward the cleaning stack 100 and removal conveyor 6. Moreover, the oscillatory movement of the deck 40 tends to roll or tumble the individual pieces of scrap so that the surfaces of the individual pieces are constantly changing position and never face in any one direction for an extended period of time.

As the shredded scrap tumbles beneath the burners 80, the high velocity flames issuing therefrom impinge against that scrap (FIG. 2) and burn oil, grease, and paint from it. Indeed, the high temperature within the fire chamber 61 is enough to single and loosen the paint, oil and grease, and consume the non-ferrous substances such as sound deadening material, rubber, upholstery and plastics. Furthermore, the tumbling created by the oscillatory motion of the conveying deck 40 tends to dislodge the ashes from the scrap metal and most of these ashes become entrained in the airstream passing through the fire chamber 61.

Once the scrap reaches the end of the conveying deck 40 the individual pieces thereof are substantially free of contaminants and are physically clean from a metallurgical standpoint, but the scrap as a whole will be mixed with some ash. This clean scrap falls onto the removal conveyor 6 along with the ashes, and while on the conveyor 6 it is sprayed with water to cool it and to flush away the dislodged ashes and other impurities. The scrap metal thereafter remaining on the conveyor 6 is acceptable for use by steel mills in making new steel.

The gaseous products of combustion and smoke as well as considerable ash in the form of particulates are entrained in the airstream passing over the conveying deck 40, and after the airstream enters the smoke elimination chamber 102 (FIG. 4) at the discharge end of the oscillating conveyor 10, its temperature is raised significantly to between 1,000°F. and 1,500°F. This elevation in temperature consumes any unburned substances and further eliminates smoke from the air stream.

Thereafter, the airstream enters the cooling chamber 116 (FIG. 4) where it encounters and flows through the serpentive path between the baffle plates 120, 122 and 124 therein. As the airstream flows along the baffle plates 120, 122 and 124, water from the nozzles 126 is sprayed through it and this cools the airstream significantly. Indeed, the spray from the nozzles 126 supplies enough water to cool the airstream to approximately 240°F. to 260°F. Aside from cooling the airstream, the spray of water from the nozzles 126 impinges against and moistens the baffle plates 120, 122 and 124, and this impingement coupled with the flow of the airstream along the baffle plates 120, 122 and 124 removes the larger particles of material from the airstream. These particulates are flushed out of the cooling chamber 116 by the spray water which cascades downwardly across the baffle plates 120 and 122 and is directed into the scrubber 130 by the drain tube 125. The scrubber 130 in turn discharges the water into the duct 137.

The cooled airstream also enters the slot-type air scrubber 130 (FIGS. 3 and 4) where by means of impingement upon wet plates and counterflow water sprays practically all of the remaining particulates are removed from it and its temperature is reduced still further. The spent water from the scrubber 130 joins the water from the cooling chamber 116 and flows downwardly, leaving the scrubber 130 by means of the duct 137. The airstream is also discharged into the duct 137.

The water stream containing the particulates removed at the cooling chamber 116 and at the scrubber 130 cascades downwardly through the duct 137 and flows onto the conical bottom wall 140 of the cyclone collector 136 (FIG. 3). Thereafter, it flows to the center of the bottom wall 140 where it enters the discharge tube 142 which directs it to the settling tank 146. The water within the settling tank 146 is relatively quiet and accordingly the particulates tend to settle to the bottom of the tank 146. In this connection, it should be noted that pump 134 draws its water from the stand pipe 148 which terminates close to the top surface of the water within the tank 146 so as to not disturb the settlement of the particulates.

The airstream, on the other hand, upon discharging from the duct 137 flows tangentially within the cyclone collector 136 and eventually loses velocity within the collector 136. The loss of velocity causes substantially all of the remaining particulates to gravitate to the bottom wall 140 and be flushed into the settling tank 146 with the water stream flowing over that bottom wall.

The airstream after having been freed of the last particulates in the cyclone collector 136 then flows through duct 154 (FIG. 1) to the fan 156 and is discharged into the atmosphere through the stack 158. The airstream so discharged, while being thin in oxygen, is for all practical purposes free of smoke and particulates and accordingly will not pollute the atmosphere.

This invention is intended to cover all changes and modifications of the example of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A high temperature cleaning apparatus for removing surface contaminants from metal segments, said apparatus comprising: a conveyor including a conveying deck having a receiving end onto which contaminanted metal segments are placed and a discharge end, and drive means for imparting an oscillatory motion to the conveying deck, the oscillatory motion being such that

the metal segments move on the conveying deck from the receiving end to the discharge end, tumbling as they do so that different surfaces of the segments are presented upwardly as the segments move along the deck; closure means extended over the conveying deck and together with the deck defining a fire chamber above the deck, the upwardly presented surface of the deck being presented toward and exposed to the fire chamber; burners in the fire chamber and positioned such that flames issuing therefrom are directed downwardly and impinge against the conveying deck and the metal segments thereon whereby surface contaminants are burned from the metal segments; ducting connected with the closure means and communicating with the fire chamber; and fan means for inducing an airstream in the ducting and through the fire chamber so that smoke and particulates resulting from the combustion of the contaminants will become entrained in the airstream and will leave the fire chamber through the ducting.

**2.** The structure according to claim **1** and further characterized by antipollution means for removing smoke and particulates from the airstream; and wherein the fan means maintains the airstream within the anti-pollution means.

**3.** The structure according to claim **1** wherein the burners extend transversely to the direction of flow along the conveying deck and further extend substantially from one side of the conveying deck to the other.

**4.** The structure according to claim **1** wherein the closure means extends across the top of the conveying deck and also downwardly at the sides thereof; and wherein the sides of the closure means are removeable, at least in part, to afford access to the conveying deck.

**5.** The structure according to claim **1** wherein the closure means comprises a frame, an insulated covering supported on the frame and extending over the conveying deck in upwardly spaced relation thereto so as to form the top of the fire chamber, and side curtains supported by the frame and defining the sides of the fire chamber, the side curtains being spaced outwardly from the sides of the conveying deck so that air can be admitted to the fire chamber from the spaces between the sides of the conveying deck and the side curtains.

**6.** The structure according to claim **5** wherein at least some of the side curtains are shiftable inwardly and outwardly relative to the conveying deck so that the width of the space between the conveying deck and the side curtains can be varied for controlling the amount of air admitted to the fire chamber.

**7.** The structure according to claim **5** wherein the side curtains are removeable to expose the fire chamber and to provide access to the conveying deck.

**8.** The structure according to claim **1** and further characterized by a water-filled pan positioned beneath the conveying deck and agitated by the drive means, the water-filled pan being close enough to the conveying deck to splash water upon the underside thereof when agitated whereby the conveying deck will not overheat.

**9.** A high temperature cleaning apparatus for removing surface contaminants from metal segments, said apparatus comprising a closure defining a fire chamber; means for heating the fire chamber; and a conveyor for transporting metal segments through the fire chamber, and said conveyor including: a base, a conveying deck supported on the base for supporting the metal segments, the conveying deck being located in the closure and exposed to the fire chamber so that the surface contaminants will be burned from the metal segments, the conveying deck being movable relative to the base and having a receiving end and a discharge end, drive means connected with the conveying deck for imparting oscillatory motion thereto, the oscillatory motion being such that the metal segments move along the deck from the receiving end to the discharge end thereof, tumbling as they do so that different surfaces of the segments are presented upwardly, a water pan mounted directly below the conveying deck for holding water and also being oscillated by the drive means, the water pan being positioned close enough to the conveying deck to enable the water therein to splash against the underside of the conveying deck as the conveying deck and water pan are oscillated by the drive means, whereby the water in the water pan will cool the conveying deck and prevent it from being distorted.

**10.** A high temperature cleaning apparatus according to claim **9** wherein the water pan is mounted rigidly with respect to the conveying deck.

**11.** A high temperature cleaning apparatus according to claim **9** wherein the heating means comprises burners which are oriented to direct the flames issuing therefrom downwardly and are positioned close enough to the conveying deck to enable the flames to impinge against the conveying deck and the metal segments thereon.

**12.** A high temperature cleaning conveyor for removing contaminants from metal segments, said cleaning conveyor comprising: an oscillating conveyor including a conveying deck having a receiving end onto which the contaminated metal is placed and a discharge end, drive means for agitating the conveying deck to cause it to advance the metal toward the discharge end, a base, a framework supporting the conveying deck and connected to the drive means, means supporting the framework on the base such that the framework can oscillate relative to the base, a laterally extending support member carried by the framework and underlying a portion of the conveying deck, a slip pad interposed between and separating the conveying deck and the laterally extending support member, and attaching means having a shank which extends through the laterally extending support member and the overlying portion of the conveying deck, the overlying portion of the conveying deck having a slot which receives the shank and extends transversely of the direction of advance along the deck, whereby the deck will not buckle when expanded by heating; closure means defining a fire chamber located above the conveying deck and arranged such that the deck and the metal segments thereon are exposed to the fire chamber; and heating means for elevating the temperature of the fire chamber sufficiently to burn contaminants from the metal segments trnasported on the deck. transported

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