United States Patent

[11] 3,559,967

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[54] **TRAVELING GRATE APPARATUS WITH HEAT SHIELDING**
10 Claims, 11 Drawing Figs.

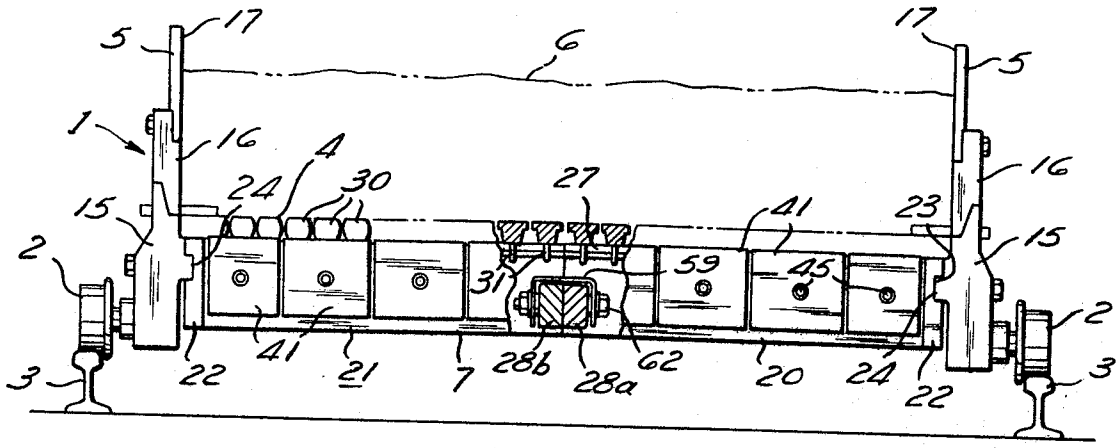
[52] **U.S. Cl.** **263/28,** 266/21
[51] **Int. Cl.** **F27b 9/00,** F27b 21/02
[50] **Field of Search** 266/21; 263/28, 50

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Primary Examiner—John J. Camby
Attorney—Bosworth, Sessions, Herrstrom and Cain

ABSTRACT: Traveling grate apparatus adapted to be subjected to severe and fluctuating elevated temperatures has supporting frame including metal supporting members, which members are substantially covered by metal shields secured to such supporting members with minimal contact areas, in order to provide heat insulating metal-to-air interfaces between the frame members and the shield to prolong the useful life of the frame.



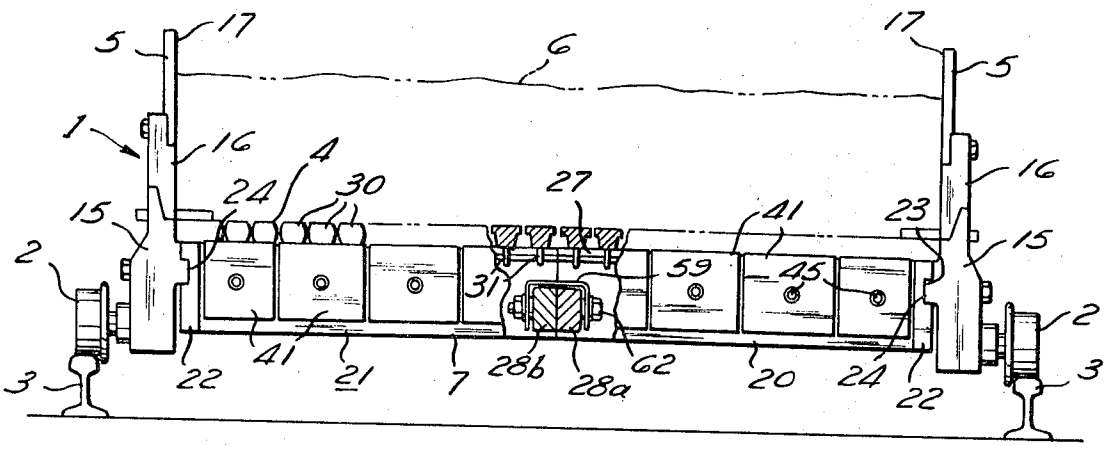


Fig. 1

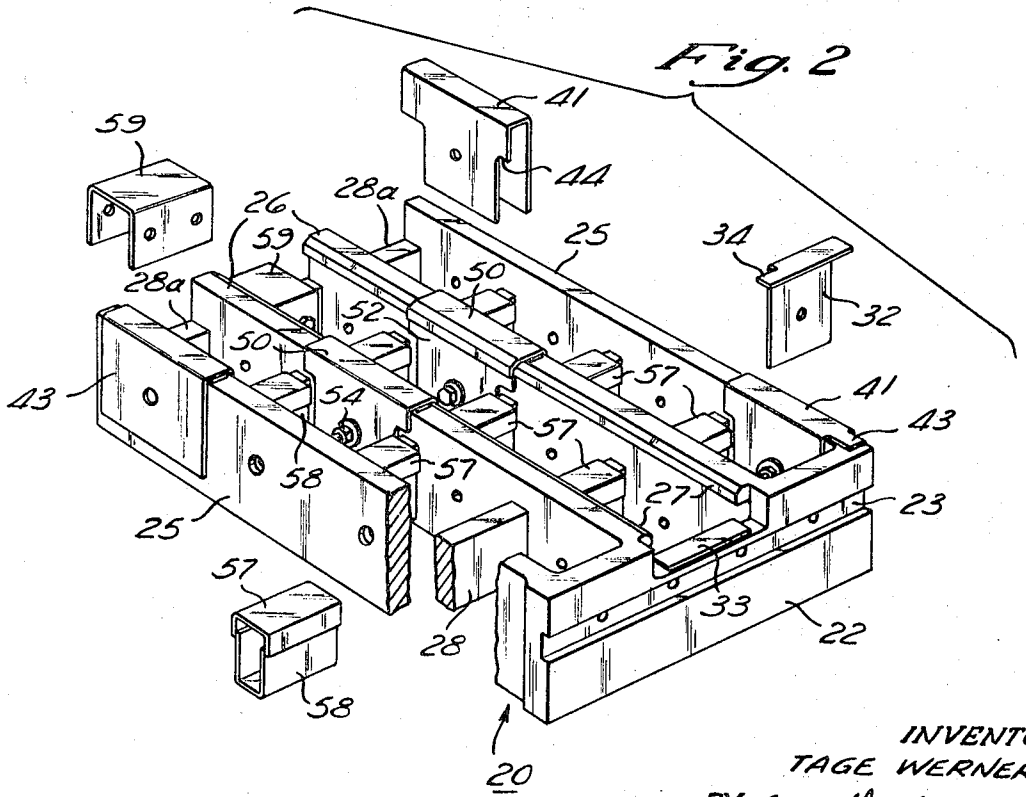


Fig. 2

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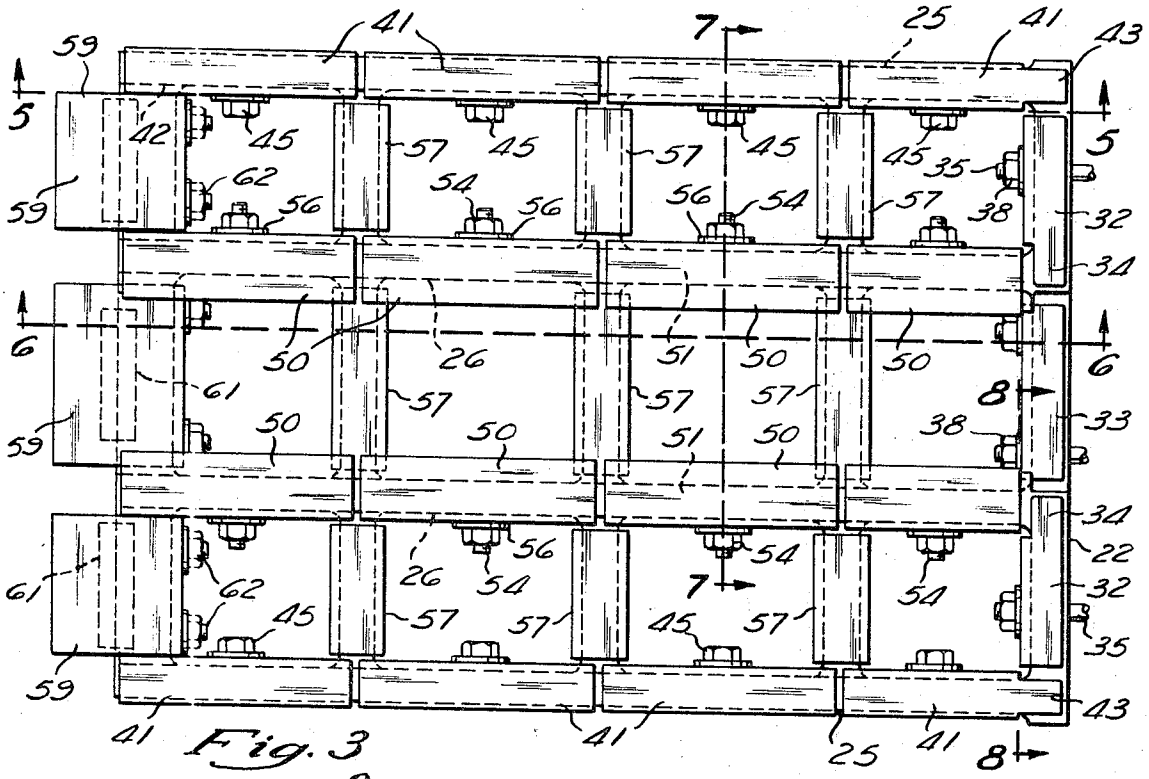


Fig. 3

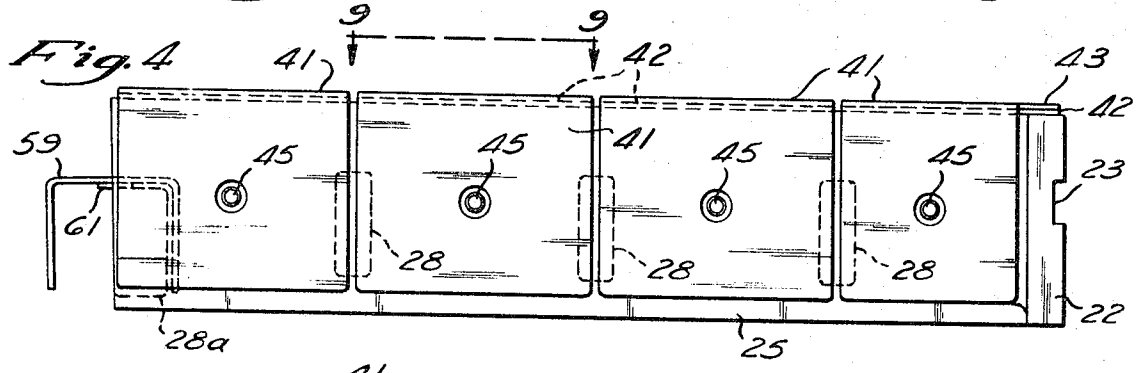


Fig. 4

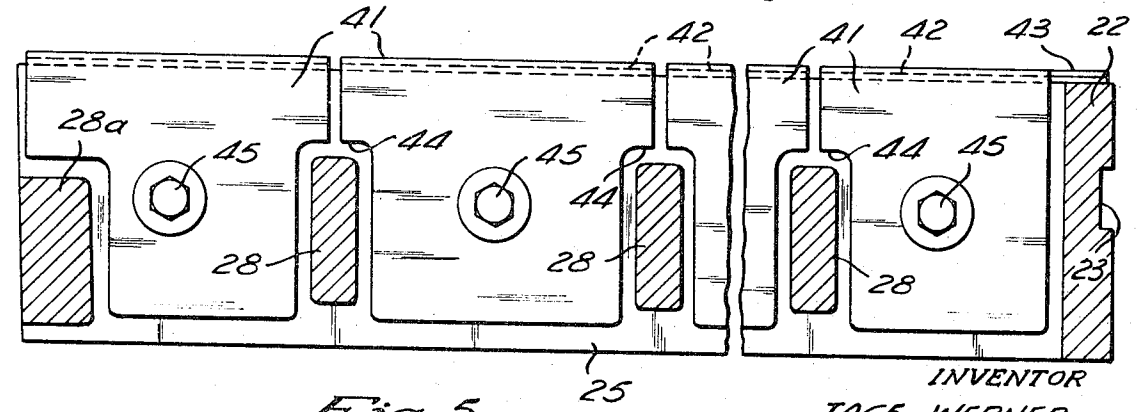
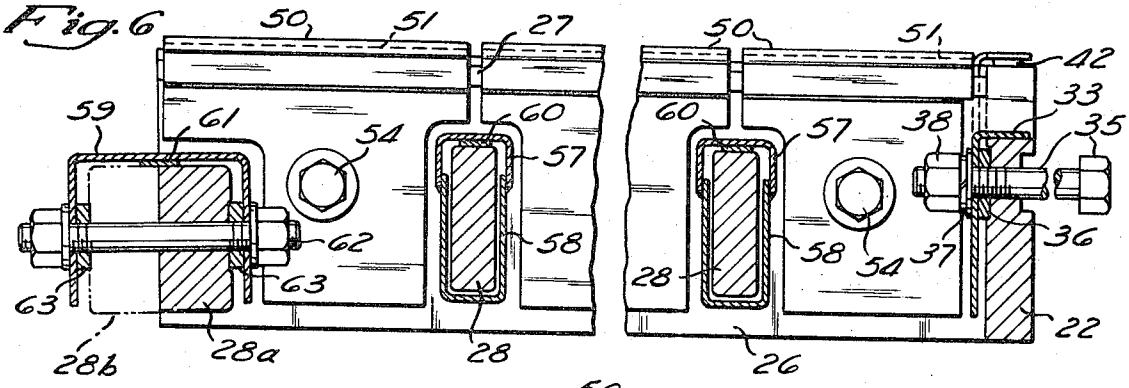


Fig. 5

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Fig. 6



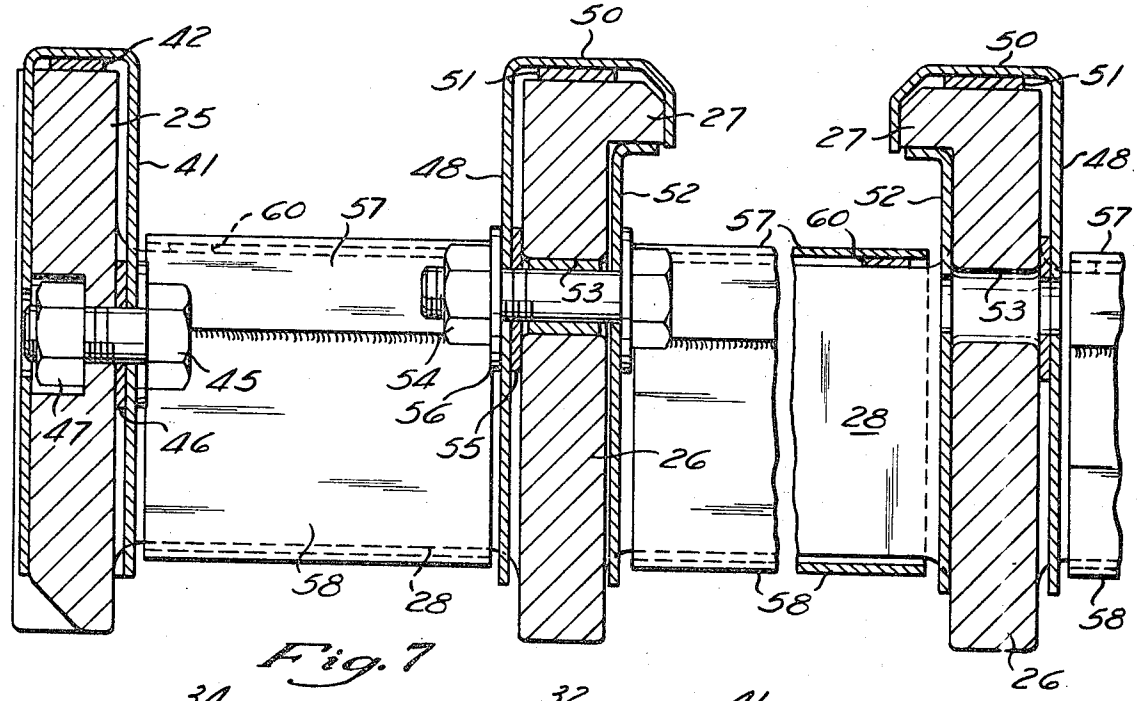


Fig. 7

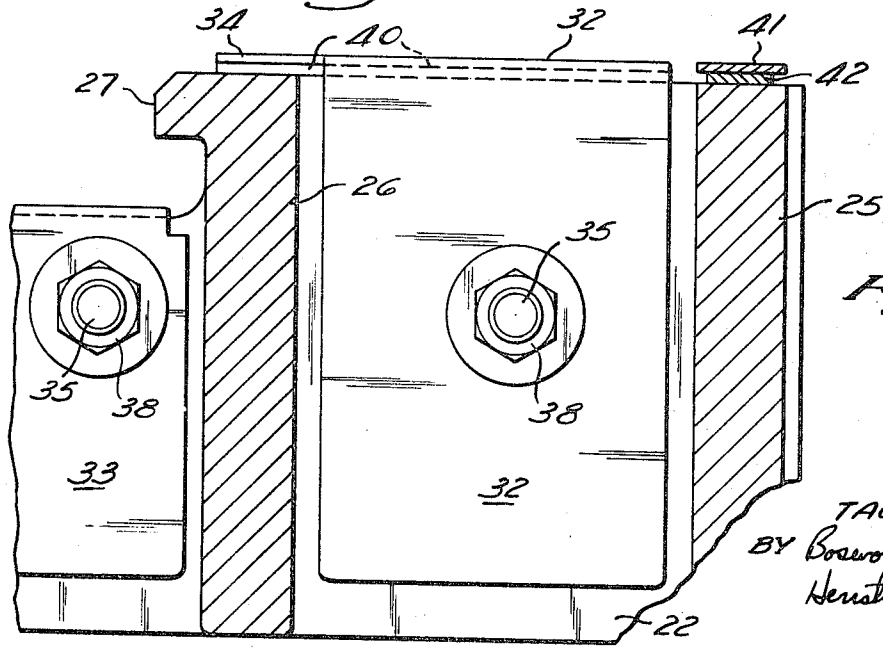


Fig. 8

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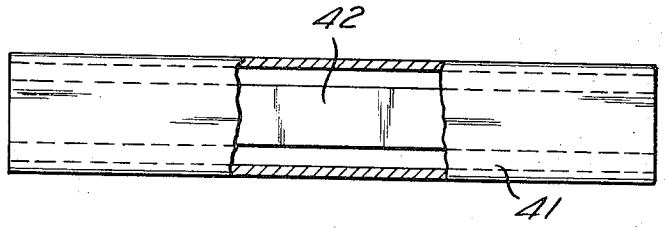


Fig. 9

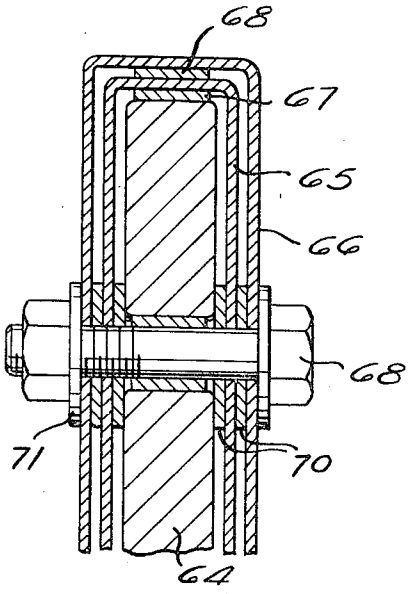


Fig. 10

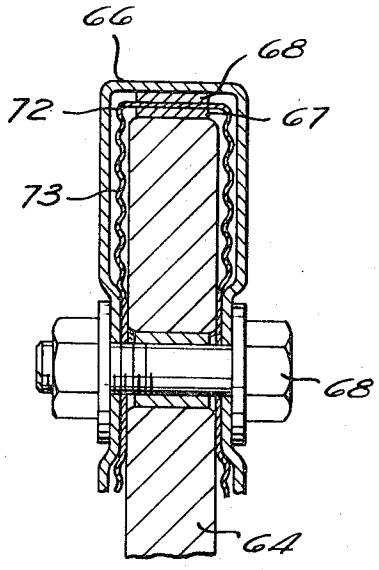


Fig. 11

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TRAVELING GRATE APPARATUS WITH HEAT SHIELDING

BACKGROUND OF THE INVENTION

The present invention relates to re traveling apparatus of the type used for treating at elevated temperatures materials such as iron ore, and more particularly it relates to traveling grate apparatus having metal supporting members heat shielded to protect them against adverse effects of severe and fluctuating temperatures.

While the invention is useful in a wide variety of treating apparatus, for convenience it will be discussed in connection with agglomeration of particulate materials such as particles of iron oxide, in which use it provides particular advantages.

When agglomerating particulate iron oxide, it is the practice to heat the material on a traveling grate apparatus in which the material is passed through one or more heating zones in which the heat applied to the material causes it to form hardened aggregates. In widely used pelletizing processes, particulate beneficiated iron ore is first formed into moist green balls which are first heated on a traveling grate to dry them, and then subjected to high indurating temperatures while on such a grate to convert the balls into heat hardened iron ore pellets that can be shipped, stored and used in blast furnaces; usually the pellets are also cooled while on the grate to cool them to temperatures permitting their ready handling. Such heating and cooling on the grate causes temperature variations to which the grate is subjected, ranging from higher temperatures in the range of 2200° F. to 2500° F. to lower temperatures in the range of 300° F. to 600° F., which variations subject the grate to severe thermal stresses.

Furthermore, many grates used in both pelletizing and sintering processes are straight horizontal grates having an upper run on which the particulate material is subjected to the heating and if desired cooling, and a lower return run in which the grate parts are subjected to considerably lower ambient temperatures as they travel back to the beginning of the upper run. This causes the grate parts to be exposed to low temperatures and consequent variations between low temperatures and high temperatures and thermal shocks.

In both pelletizing and sintering apparatus the material on the grate is subjected to the various treating temperatures by hot gases passed through the grate, which has a permeable bottom for that purpose. The permeable bottom of such a grate in general comprises movable bars that are held in a frame, spaces being provided between the bars over substantial portions of their length for passage of gases. The supporting members of the frame are subjected to the fluctuating temperatures described above.

The repeated drastic heating and cooling to which the frame members are subjected for the above reasons, tend to cause them to deteriorate and to sag, warp, twist or otherwise distort. Such distorting can cause the frames to jam in their supports to an extent to prevent operation of the traveling grate apparatus, or prevent desired removal and replacement of grate bars; the deterioration, moreover, can in time so weaken the frames as to cause them to fail.

In time, such deterioration or distortion becomes so great that the frame members must be replaced, which often requires shutdown of the traveling grate apparatus with consequent loss of production during the time required for replacement, and also involves substantial economic losses because portions of the traveling grate must be discarded. In large installations such losses could run into tens of thousands of dollars. These tendencies are accentuated because of modern practices which involve the use of higher temperatures and greater temperature spreads.

Various attempts have been made to ameliorate these difficulties. Often such attempts have involved making the frame members of the traveling grate of expensive alloy steel castings rather than lower cost cast iron or ordinary steel castings. This involves greatly added cost over the cost of grates made of less expensive material, but still can eventually result in the necessity for replacing grate portions because of the distorted supporting members.

Other proposals have involved using grate frame members of special design including those having massive supporting members, specially recessed members, etc. While in U. S. Pat. No. 3,384,355 it has been proposed to provide heat shields resting on the upstanding sidewalls of a traveling grate, applicant knows of no attempt to protect the supporting members of the grate in which the tendencies to deteriorate or distort are much more serious because of their direct exposures to hot gases, which are more complicated in structure and therefore present different and more difficult problems because of their complexities of shapes, and when are load bearing and must include provision for supporting the grate bars so they are securely held in place during operation of the grate but can be readily removed if desired.

SUMMARY OF the THE INVENTION

According to the present invention, the supporting members of a traveling grate have metal shields that substantially cover, and preferably essentially completely cover, the surfaces of the frames that are exposed to heat. These shields are attached to the frame with minimal contact; and preferably each shield is attached in such a manner as to permit virtually free expansion and contraction when exposed to heat. The shields are so mounted that they provide large metal-to-air interfaces between the supporting members and the shields, which provide heat insulation and which prolong the useful life of the supporting members. If desired, superposed metal shields may be used over part or all of the supporting members.

DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate embodiments of the invention in which:

FIG. **1** is a front elevation, partly in section, illustrating a type of traveling grate pallet which can be heat shielded in accordance with the present invention:

FIG. **2** is an isometric view of the frame of the pallet of FIG. **1** and illustrates the relative positions of some of the metal shields, some of which are shown in exploded view;

FIGS. **3** and **4** are plan and end elevations, respectively, of the pallet frame of FIGS. **1** and **2**;

FIGS. **5** through **8** are sections of FIG. **3** on the indicated section lines corresponding to the numeral of the figure;

FIG. **9** is a section of FIG. **4** on the line **9–9** with parts broken away for purposes of illustration;

FIG. **10** is an end elevation of a pallet frame member having a modified form of shield, the shield being shown in section for purposes of clarification; and

FIG. **11** is also an end elevation of a pallet frame member having a modified form of shield, the shield again being shown in section for purposes of clarification.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For convenience, the invention is discussed below in connection with pallets of a straight, generally horizontal traveling grate pelletizing apparatus. Such grate comprises a number of abutting pallets, generally indicated at **1**, each of which has wheels **2** that roll on rails **3**. Each pallet has a gas-permeable hearth portion **4** and upstanding sidewalls **5** that, with corresponding parts of abutting pallets, define a channel-shaped cross section in which the material **6** being heated is carried.

As shown in FIG. **1** each pallet comprises a frame **7** in which cast metal side beams **15** are bolted to sections **16** which are bolted, in turn, to plates **17**, members **16** and **17** defining the upstanding sidewalls **5**. The side beams **15** are joined one to the other through the pallet frame and carry the conventionally journaled wheels **2**.

In the embodiment shown, the pallet framework comprises two integrally cast, identical, metal half-sections **20** and **21**, of which one section **20** is depicted in FIGS. **2–10**. Each section

has the same construction and comprises an outer transverse member **22** having a longitudinal slot **23** which mates with a similarly shaped projection **24** on a side beam **15** of the pallet. Four spaced, parallel supporting members extend from each member **22**. The outer two members **25** are identical, and the inner two members **26** are similar except for lip portions **27** which extend toward one another. Spaced, parallel crossmembers **28** and **28***a* extend between the members **25** and **26** to reinforce the pallet frame and usually are at lower elevation than the member **25** and **26**. The innermost crossmembers **28***a* of each pallet section are bolted to each other to secure the two sections together as a single unit.

A number of grate bars **30** are supported atop the members **25** and **26**, point in a direction paralleling the sidewalls **5**, and extend from one sidewall to the other (FIG. **1**). In the embodiment illustrated, the grate bars **30** are of standard construction and have periodic necked-down widths (not shown) to permit the passage of gases between bars. The grate bars **30** have conventional depending hooks **31** which extend under the lip portions **27** of members **26** to hold the bars in place when the pallet is in material carrying position as shown.

In practice, the bars **30** immediately support the material **6** being treated. From FIGS. **1** and **2** it will be seen that the upper faces of members **25** and **26** carry the grate bars. Crossmembers **28** and **28***a* are at a lower elevation and do not contact the bars **30**.

In the embodiment illustrated by FIGS. **1** through **10**, all of the pallet frame members have some heat shielding. As a general rule, only the top and side faces of a member are heat shielded because in this case the hottest gases to which the pallet is subjected pass downwardly through the material on the grate and through the grate in the indurating or sintering zone through which the grate passes; however, the extent of areas shielded may differ. For example, members **22** have only the upper and inner faces shielded, so that the outer faces may mate with a side beam **15** as described. On the other hand, crossmembers **28** have all four sides heat shielded (FIG. **6**). Further, members **25** ad and **26** are not shielded along their bottom faces (FIG. **7**), since the heat exposure is not as severe here. Also, these members repeatedly contact dead plates forming seals between separate treating zones and, if shielded, the shields would tend to tear from such repeated contact.

In general, the shields may be a of any suitable sheet material, such as common cold rolled steel, but they may be formed of alloy metal if desired. The shields are designed to fit about only relatively short lengths of a frame member. A number of shields are then placed end to end, to cover a particular frame member as may be desired. Also in determining the shape of a particular heat shield, the proximity of the shield to other members, projections, junctures of members to members, corners, etc. are taken into account in establishing the actual size and geometric shape and design of the shield.

Ideally, a shield would float with respect to a protected member, that is, there would be a continuous, uninterrupted air envelope between the shield and member. However, since some attachment between the shield and member is necessary, the securing area preferably desirably is maintained at a minimum. Preferably, each shield is secured by a single fastening means which fixes essentially a point on the metal shield to a face of the metallic support member, as by spot welding, a bolt, or the like. Further, where contact between the shield and a frame member is unavoidable, this contact is again preferably held to a minimum, as by spacing means which holds the shield away from the member while maintaining a physical contact between the shield and member of minimum practicable area. The reduced heat conductivity at the metal-air interface at each side of each shield provides considerable heat insulation for the metal frame members, so that they remain at lower temperatures and in this manner are less susceptible to deterioration.

Referring specifically to the shapes of the shields used in the embodiment of FIGS. **1** through **10**, the edge member **22** has invented L-shaped shields **32** and **33** which cover the inner and upperfaces of the member. The outer face of member **22** must be free to butt against a side beam **15**. The longer legs of the L-shaped shields **32** and **33** cover the inner face of member **22** as indicated, while the shorter legs of the shields cover the top face. Shield **33** is shorter than end shields **32**, since edge member **22** is recessed at its medial section (FIGS. **2** and **6**). Shields **32** have tabs **34** on their shorter legs which extend toward each other and cover additional area atop the edge member **22**.

All of the shields **32** and **33** have single fastening means in the form of bolts **35** which pass through the shield, edge member **22**, and the end beam **15** at the juncture of the interfitting groove **23** and projection **24**. The single bolt fastening means includes a spacer **36**, lock washer **37**, and nut **38**. The end shields **32** (FIG. **8**) have strip spacers **40** beneath the shorter legs which are fixed by welding to the shield. Alternatively, the strip spacers **40** could be fixed to the top face of the member **22**. In either case, these spacers reduce the area of contact between the shorter legs of the shields **32** and member **22** and are in strip form because member **22** is load bearing.

The outer two members **25** of the pallet frame are similarly shielded, so that only one is described in detail. The shields **41** for these members (FIGS. **3**, **4**, and **5**) are all of inverted U-shape and have strip spacers **42** beneath their bight portions. FIG. **9** illustrates a strip spacer **42** and in general what is encompassed herein by that term. Preferably, a strip spacer corresponds in length to the length of the shield to which it is attached in order to bear a load, but the strip spacer has a reduced width as compared to width of the bight portion of the shield. The smaller area of the strip thereby reduces the conduction of heat through the strip. The bight section of the outermost shield **41** on each member **25** has a tab **43** which covers the end corner of the members. The inner sides or legs of the U-shaped shields **41** have cutaway sections generally indicated by reference character **44** (FIG. **5**) to accommodate cross members **28** and **28***a*. Single bolt connectors **45** pass through a member **25** from an inside face to join the leg portions of each shield **41** (FIG. **7**). The bolts have ring spacers **46**, while the outer face of a member **25** has a recess matching the shape of a nut **47** for the bolt.

The inner two members **26** of the pallet frame are also similarly shielded, so that only one is described in detail. In this case two-piece shields (FIGS. **3** and **7**) are used. One of the pieces **48** has an inverted J-shape covering a side face of a member **26** with its larger leg section and extending a turned end **50** to embrace the upper face of a member **26** as well as its lip portion **27**. A strip spacer **51**, such as the one illustrated in FIG. **9**, lies beneath the turned end **50** and freely seats against the upper face of a member **26**. Another piece **52** cooperates with piece **48** in covering a member **26**. Piece **52** is planar with a right angle edge turn which fits beneath a lip portion **27**. Members **26** have a single opening **53** for each shield through which a bolt-nut combination **54** passes to secure the pieces **48** and **52** relatively to each other and to a member **26**. The bolt has a spacing collar **55** and a washer **56**.

It will be appreciated that in FIGS. such as FIG, **7**, the thickness of the shields has been exaggerated for purposes of illustration. Actually, it is the heat insulating properties of the air-metal interface on each side of a shield that is important in providing protection from heat rather than the thickness of the shield. The shield can be as thin as practical as long as it is self-supporting and avoids warping. Referring to the center of FIG. **7**, it will be noted that spacing collars are not necessarily used. Spacing collar **55** is used between shield **48** and member **26** in the center of FIG. **7**, but none is used on the opposite side between shield **52** and the member. In cast metal parts, such as the member **26**, the natural roughness and surface irregularities of the casting inherently result in spacing of a shield. This minimizes appreciable metal-to-metal contact and does provide a substantial air-to-metal interface.

All four faces of the crossmembers **28** are heat shielded by two telescoping U-shaped sections **57** and **58** (FIG. **6**). The upper section **57** is shorter, overlaps the lower section **58** and

is welded thereto along the ends of its legs. Strip spacers **60** (FIGS. **3** and **6**) fit between the bight portion of section **57** and the top face of a member **28** and preferably are not fixed with respect to either part. The innermost crossmembers **28***a* are at a somewhat lower elevation than crossmembers **28** (FIG. **6**) and have inverted U-shaped heat shields **59** These shields have bight portions of sufficient length to bridge two such crossmembers in order to unite half-section **20** of the pallet frame to identical half-section **21** and form a single unit (FIG. **1**). FIG. **6** illustrates in phantom the cooperating crossmember **28***b* of a companion framework. A strip spacer **61** beneath the bight section of a shield **59** rests upon both of the joined cross members **28***a* and **28***b*. These members have aligned openings to accommodate a bolt-nut combination **62** having spacers **63**. In this instance, it may be advisable, as shown, to have two of such bolts for each shield **59** and protect members **28***a* and **28***b* in order to provide a sufficiently strong connection between the two similar frames defining the pallet.

FIGS. **10** and **11** illustrate two modifications of the present heat shielding. In certain installations, parts of the pallet framework may be more severely exposed to heat than other parts. In this case, a number of superposed metallic shields may be used, preferably with the same single fastening and with spacing means. For example, in FIG. **11** a frame member **64** has two inverted U-shaped shields **65** and **66** successively placed around it. Spacing means **67** separates the top face of member **64** and the bight portion of shield **65**, and spacing means **68** separates the bight portion of shield **65** from that of shield **66**. To secure shields **65** and **66** to the member **64**, a single bolt and nut combination **68** may be used. Preferably the bolt has spacers **70** interleaved between the shields **65** and **66** and a lock washer **71**. The severest heating conditions usually occur at the top of the frame members and therefore the embodiment of FIG. **10** can be especially advantageous.

The embodiment of FIG. **11** is similar to that of FIG. **10**, except that an inner shield **72** is much thinner than shield **65** and has legs corrugated or dimpled as at **73**. It will also be noted that the embodiment of FIG. **10** omits spacers for the bolt such as the spacers **70** of FIG. **10**. The remaining parts are similar to those of FIG. **10** and have, therefore, been indicated by like numerals.

If desired, one or more of the heat shields may have a highly reflective surface. This increases the insulating effect by adding heat reflectivity to the reduction in heat conductivity provided by the air-metal interfaces. By means of the present shields the range of fluctuating temperatures is narrowed, so that there is less thermal variance and shock on the frame and its attendant parts. The shields tend to stabilize the temperatures by reducing both the abruptness and magnitude of changes in temperature to which the frame members of the grate are exposed.

It is understood that frame members heat shielded in accordance with the present invention, may support grate members of traveling straight grates or traveling circular grates.

While the foregoing describes several embodiments of the invention, it is understood that other modifications may be made within the scope of the following claims.

I claim:

1. In traveling grate apparatus having a moving grate and including a frame that is subjected to severe and fluctuating temperatures and that comprises at least one metal supporting member, a metal shield substantially covering the surface of said supporting member that would otherwise be exposed to heat and having a minimal attachment to the member to provide a metal-air interface adjacent said supporting member of substantial area that substantially reduces heat transferred to said member substantially to reduce deterioration of the member by heat and to prolong useful life of said member, wherein said minimal attachment includes fastening means that permits substantially unrestrained movement of said shield relative to said supporting member during thermal expansion and contraction thereof while maintaining said metal-air interface between said shield and supporting member.

2. The apparatus of claim **1** wherein said minimal attachment includes single fastening means securing essentially a point of the metal shield to a face of the metal supporting member.

3. The apparatus of claim **1** including spacing means interfitted between the metal shield and a face of the metal supporting member and effective to aid in forming said metal-air interface.

4. The apparatus of claim **3** wherein said spacing means is in strip form.

5. The apparatus of claim **3** wherein said interfitted spacing means is not fixedly secured to either the shield or support member.

6. The apparatus of claim **1** wherein at least one section of said shield is corrugated.

7. The apparatus of claim **1** wherein a plurality of superposed metal shields cover said interconnecting metal supporting member, each metal shield having an insulating metal-air-metal interface with its contiguous companion shield.

8. The apparatus of claim **7** wherein all of the metal shields have a common attaching means securing the shields to a metal supporting member.

9. Grate apparatus adapted to be subjected to severe and fluctuating temperatures having a frame to support a load, said frame comprising spaced-apart metal members held in fixed relation by spaced-apart crossmembers, a strip spacer on a face of said members, a metal shield fitted over members and resting upon said strip spacers, and single fastening means securing essentially a point of each shield to its protected support member.

10. The apparatus of claim **9** wherein said crossmembers are at a lower elevation than said metal members.