Feb. 13, 1973 R. L. CORBETT, JR 3,716,223

LOAD SUPPORT DIFFUSER AND METHOD OF MANUFACTURE

Filed Feb. 10, 1971 2 Sheets-Sheet 1

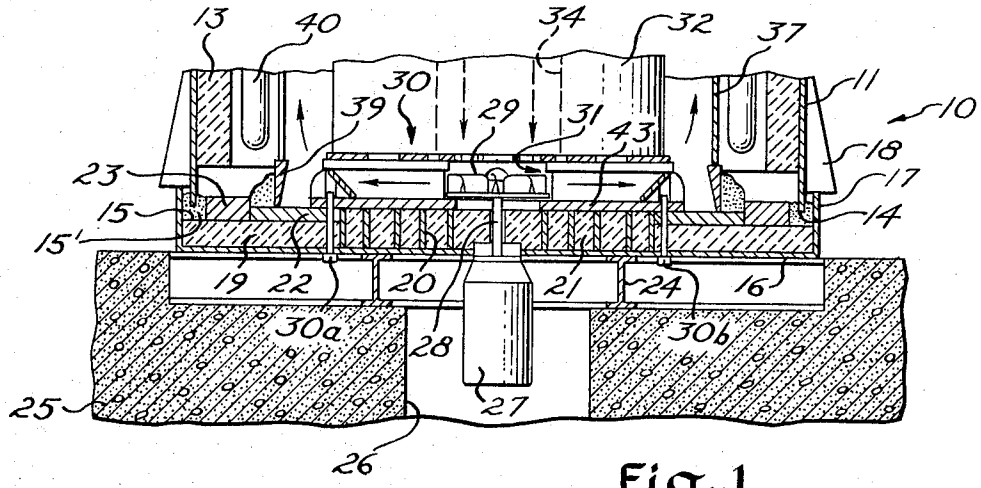


Fig. 1

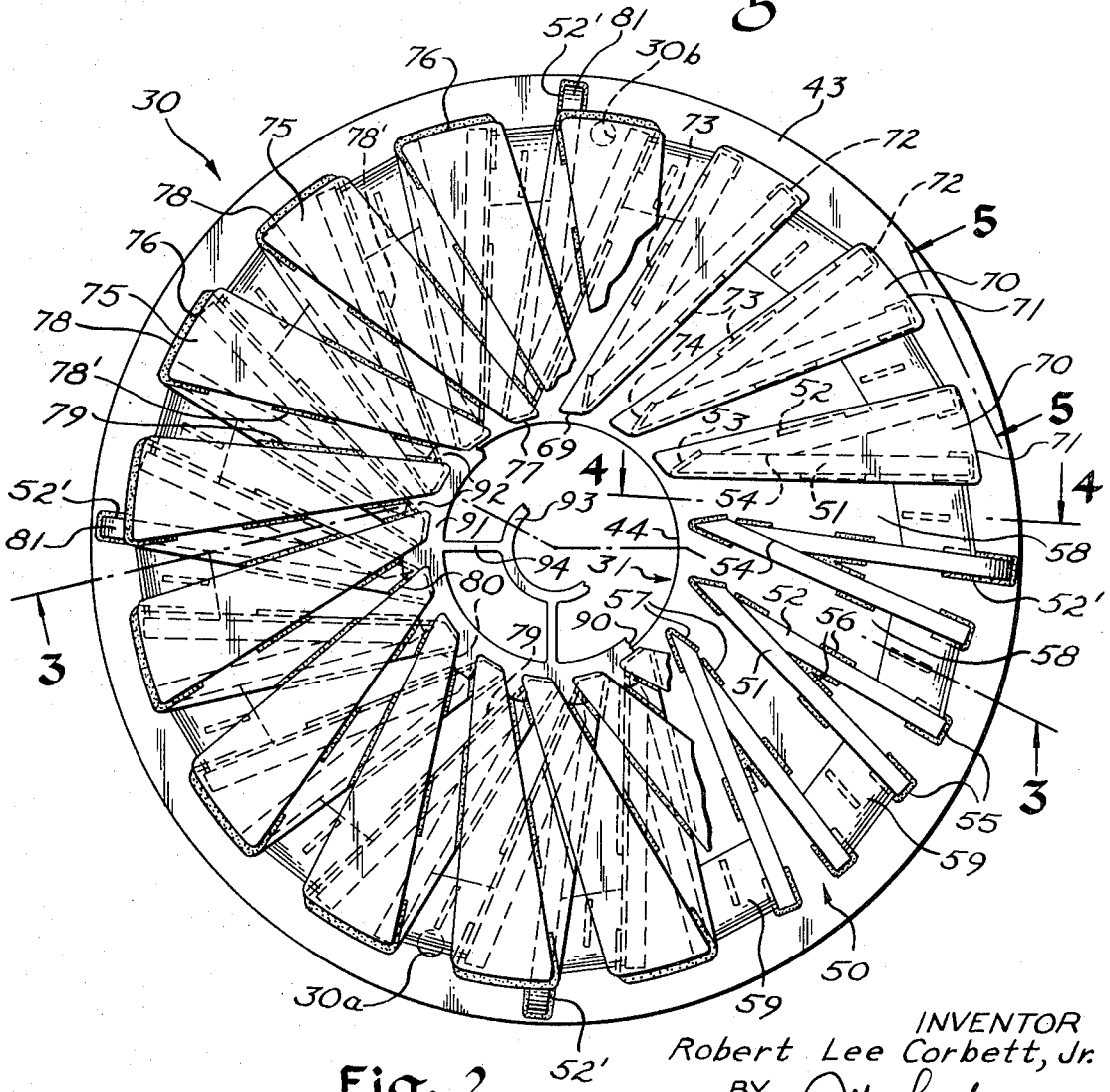


Fig. 2

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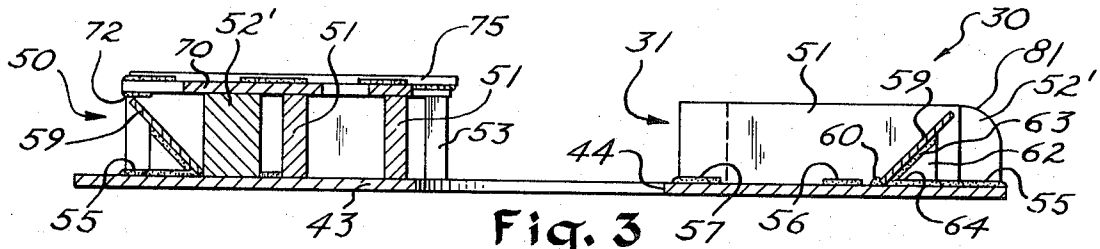


Fig. 3

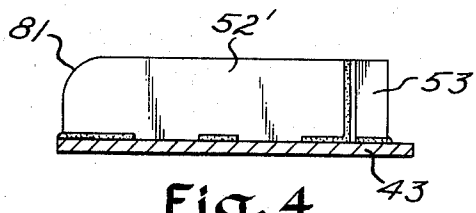


Fig. 4

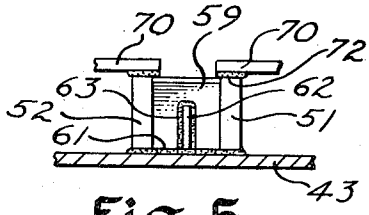


Fig. 5

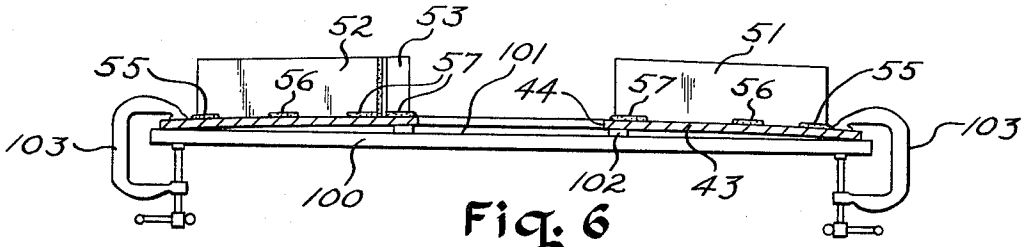


Fig. 6

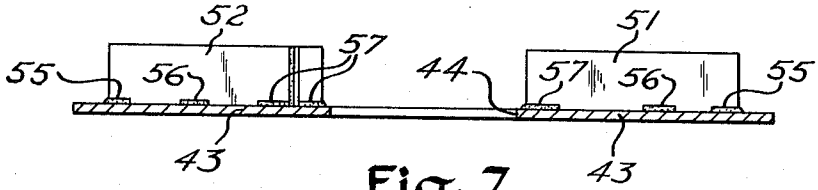


Fig. 7

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United States Patent Office 3,716,223
Patented Feb. 13, 1973

3,716,223

LOAD SUPPORT DIFFUSER AND METHOD OF MANUFACTURE

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Filed Feb. 10, 1971, Ser. No. 114,151
Int. Cl. F27d 5/00
U.S. Cl. 432—260 9 Claims

ABSTRACT OF THE DISCLOSURE

There is disclosed herein a load support diffuser adapted to support a vertical stack of coils in an annealing furnace and diffuse a protective atmosphere gas within said furnace, the diffuser comprising a flat circular base plate, V-shaped flow divider members mounted on top of the plate and having the apices thereof directed inwardly to define a central opening for a blower and defining outwardly directed flow passages, deflectors for diffusing the gas upwardly at the outer ends of the flow passages, and a double layer of oppositely skewed support bars carried by the flow divider members.

This invention relates to annealing furnaces adapted for treating coils of strip metal and relates more particularly to a load support diffuser adapted to both support a charge of coils stacked endwise within a furnace and also diffuse a protective, nonoxidizing atmosphere gas within the furnace.

In a known form of the type of furnace referred to, the coils of strip metal are stacked coaxially upon a suitable base structure and have a recirculating fan or centrifugal blower disposed therebelow. Each coil has a coaxial central opening or eye, and the blower is adapted to circulate a heated, protective atmosphere gas upwardly around the outside of the coils and downwardly through the eyes of the coils, or to similarly circulate a cooling gas. Coil separators or convector plates are preferably providel between adjacent coils, said separators providing passage means allowing the gas to circulate between the coils and across the edges of the coil wraps. The stacked coils are preferably closed within a gastight inner cover which is, in turn, disposed within a suitable furnace having radiant tube burners or other suitable heating means for heating the inner cover and the atmosphere gas confined within the inner cover.

It will be readily apparent that the load support means in the above type furnace is subjected to substantial pressures in use due to the fact that it supports the entire weight of all of the coils. It will also be apparent that the load support is subject to a wide range of temperature changes which tend to cause said support to distort. A load support of the type herein disclosed is substantially hollow, passage means being provided therein for rapidly diffusing and recirculating the gas whereby the problem of structural strength anl distortion due to temperature changes are accentuated. Reinforcing structure must not interfere with the circulation of the gas and at the same time must be sufficient to afford a strong, durable structure not subject to distortion under pressure and temperature changes. Additionally, it is important that the load support have an upper, load bearing surface having an area sufficient to prevent damage to the edges of the coil wraps. These and many other problems which are encountered in connection with the manufacture and use of load supports of the diffuser type have been solved in an improved manner by the invention disclosed herein.

The general object of the invention is to provide an improved load support diffuser as set forth above having improved means for diffusing the heated atmosphere gas from below a stack of coils.

in an annealing furnace and diffusing an atmosphere gas thereto.

Another object of the invention is to provide an improved load support diffuser as set forth above having improved passage means therein for diffusing the heated atmosphere gas from below a stack of coils.

Still another object of the invention is to provide a load support diffuser so constructed as to resist distortion due to extreme tempearture changes.

Yet another object of the invention is to provide a load support diffuser having supporting surface means sufficient to support the coils without damage to the edges of the coil wraps, said support also affording adequate circulation of the atmosphere gas across the axially directed ends or edges of the coil wraps.

A still further object of the invention is to provide in combination with a load support diffuser set forth above, centering means for centering the inner cover with respect to the charge.

A still further object of the invention is to provide, in combination with a load support of the above type, deflector means at the outer ends of the passage means for deflecting the gas upwardly around the charge.

Yet another object of the invention is to provide improved means for mounting the deflector means of the foregoing object.

Another object of the invention is to provide a load support diffuser as set forth above which is of simple, sturdy construction, inexpensive to manufacture, and highly durable in use.

Other objects of the invention and the invention itself will be readily apparent to those skilled in the art to which it appertains upon consideration of the following description of the invention and the accompanying drawings, in which said drawings:

FIG. 1 is a fragmentary longitudinal section through the lower base portion of an annealing furnace containing a stack of strip steel coils disposed upon the load support diffuser of this invention;

FIG. 2 is a substantially enlarged, generally top plan view of the diffuser with certain portions thereof being removed to clarify the construction;

FIG. 3 is a section taken along the line 3—3 of FIG. 2;

FIG. 4 is a section taken substantially along the line 4—4 of FIG. 2;

FIG. 5 shows the outer end of one of the flow passages as seen from the line 5—5 of FIG. 2; and

FIGS. 6 and 7 show two steps in the method for manufacturing the load support diffuser of this invention.

Referring now to the drawings in all of which like parts are designated by like reference numerals, FIG. 1 shows, in section, the lower portion of a hood or bell type furnace **10** comprising a cylindrical body portion **11** and a suitable refractory lining indicated at **13**. The cylindrical body portion **11** is preferably formed of heavy sheet metal and has a downwardly projecting, annular flange portion **14** which projects into a granular sealing trough **15** of a generally cup-shaped base **16**. The base has an upwardly projecting, annular flange **17** having a slightly larger diameter than the flange portion **14** whereby said flange portion **14** is disposed generally within said annular flange **17**. The body portion **11** is supported by radially projecting fins **18** the bottom edges of which seat upon the upper edge of the annular flange **17**. The base **16** also includes a suitable refractory bottom lining **19** and a central support structure comprising concentric steel rings **20** having refractory material **21** disposed therebetween. An annular plate **22** surrounds the concentric rings **20**, and a larger annulus **23** is disposed outwardly therefrom and forms the inner wall of the granular sealing trough **15**. Said trough is filled with a suitable

granular sealing material 15', such as sand, into which the flange portion 14 projects.

The base 16, as herein illustrated, is securely mounted upon I-beams 24 which are seated in a concrete floor 25 or other suitable supporting means. A central cavity 26 in the floor 25 affords space for mounting a motor 27 having a shaft 28 which projects upwardly through the central portion of the base 16, the upper end of said shaft carrying a centrifugal fan or blower 29. The blower 29 is disposed within a central opening 31 of the load support diffuser of this invention, said load support diffuser being generally indicated at 30 and being hereinafter fully described in detail in connection with FIGS. 2–7. An atmosphere gas inlet 30*a* and an atmosphere gas outlet 30*b* project upwardly through the base 16 into said load support diffuser at the periphery thereof.

The diffuser 30 supports a plurality of coils 32 of strip sheet metal stacked vertically and coaxially within the body portion 11, only the bottommost of said coils being shown in FIG. 1. It will further be understood that the coils are preferably separated by coil separators or convector plates (not herein illustrated) as is well-known to those familiar with the art. Each coil defines a central opening or eye 34, the eyes of all of the coils being aligned to provide a central opening through the stack of coils.

A cylindrical inner cover 37 is disposed over the stacked coils 32, said inner cover having a lower, annular base portion 39, which seats upon the annular plate 22 outwardly of the gas inlet 30*a* and gas outlet 30*b* and is sealed thereto by granular sealing means, such as sand, indicated at 39'. In the form of the invention shown, heating means for the furnace comprise elongated, gas-fired radiant tube heaters 40 which are evenly circumferentially spaced around the outside of the inner cover 37 within the refractory lining 13.

Referring now to FIGS. 2 and 3, the load support diffuser 30 comprises a circular metal base plate 43 having a central aperture 44 through which the shaft 28 of the motor 27 projects. The base plate 43 seats upon the upper edges of the annular rings 20 with the outer circumferential edge portion thereof overlapping the annular plate 22. The centrifugal blower 29 is disposed above the base plate 43 and circulates the protective atmosphere gas radially outwardly with respect to said base plate.

The upper surface of the base plate 43 carries a plurality of circumferentially spaced, V-shaped flow dividers 50 adapted to define passages 58 therebetween for directing the outward flow of the atmosphere gas. As herein illustrated, the flow dividers 50 are metal members which extend from points adjacent to the outer periphery of the base plate 43 inwardly to points adjacent to the inner periphery defining the central aperture 44 of said base plate. Each flow divider comprises a pair of diverging walls 51 and 52 which, in the form of the invention herein illustrated, are made from heavy, thick bar stock disposed on one side edge thereof and welded to the upper surface of the base plate 43. As herein illustrated, the wall 51 is relatively longer than the wall 52 and extends inwardly to a point closely adjacent to the edge of the aperture 44, its inwardly directed portion having a short taper or bevel 53 to afford a sharp inner end to the flow divider 50. The arm 52 converges inwardly with the arm 51 intersecting the same adjacent to the bevel 53 and being itself angled or beveled at 54 adjacent to said wall 51 at an angle equal to its angle of convergence. The two walls 51 and 52 are rigidly welded together as well as being welded to the base plate 43. It will be noted that the elongated walls 51 and 52 are welded to the base plate 43 at separated areas as indicated by welds 55 at their outer ends, short welds 56 adjacent to medial portions and where the walls converge, and welds 57 adjacent to the ends of said walls. This discontinuous or stitch welding allows for a difference in the rate of expansion and contraction of the base plate 43 and the heavy bar stock of the walls 51 and 52.

The flow dividers 50 are so disposed upon the base plate 43 that their center lines are skewed in the same circumferential direction with respect to true radii of the base plate. The said flow dividers are circumferentially spaced apart whereby to provide therebetween the gas flow passages 58 which extend from a point adjacent to the central aperture 44 outwardly to a position adjacent to the outer periphery of the base plate 43. The passages 58 widen slightly in the outward direction, their outer end portions being provided with outwardly and upwardly angled deflector plates 59.

Referring now particularly to FIGS. 3 and 5, each deflector plate 59 as herein illustrated is disposed at substantially a 45° angle and extends laterally substantially the full width of the passage between two adjacent flow dividers 50. However, it will be noted that neither side edge of the deflector plate is welded to the adjacent wall 51 or 52. Each deflector plate 59 is welded on both sides of its lowermost edge to the upper surface of the base plate 43 as indicated by the welds 60 and 61 in FIGS. 3 and 5, respectively. Each deflector plate is further supported by a vertically disposed, centrally located triangular gusset plate 62 which is welded to the lower surface of said deflector plate along an angled edge 62' thereof, and to the base plate 43, by welds 63 and 64, respectively. Thus each deflector plate 59 is firmly anchored in its respective passage way but is unaffected by relative expansion and contraction of adjacent flow dividers 50 and the circular base plate 43.

From the foregoing it will be readily seen that the gas flow passages 58 are angled or skewed with their inner ends being offset in a counterclockwise direction with respect to the outer ends thereof. The passages are thus adapted to receive outflowing gas impelled by the centrifugal blower 29 which rotates in a clockwise direction.

Each of the flow dividers 50 carries a flat bar 70 of substantially heavy metal stock, said bar tapering inwardly along its side edges and terminating at its inner, smaller end radially inwardly a slight distance beyond the inner ends of said flow dividers. The outermost edge 71 of each said bar is disposed radially outwardly from the outer ends of the flow dividers and radially outwardly beyond the outwardly and upwardly disposed edges of the deflector plates 59. The bars 70 are disposed substantially in alignment with the flow dividers 50 and completely cover the V afforded by the angled walls 51 and 52. Each bar 70 is substantially angled or skewed with respect to a true radius of the base plate 43, all of said bars being skewed the same amount in the same circumferential direction.

A second layer of flat bars 75 is superimposed upon the layer of bars 70. The bars 75 are the same shape as seen in plan view as the bars 70 but are skewed or angled in the opposite circumferential direction whereby each said bar 75 overlaps three of the bars 70. It will be noted that the outermost edges of the bars 75, indicated at 76, are inset slightly in a radial direction with respect to the outermost edges 71 of the bars 70. This results in the innermost edges 77 of the bars 75 inwardly overhanging or projecting inwardly beyond corresponding innermost edges 69 of the bars 70.

Each bar 70 is welded to the upper edges of the flow divider walls 51 and 52 by a pattern of welds similar to those welding the flow dividers to the circular base plate 43. The outer ends of the walls 51 and 52 are provided with welds 72 which extend across the ends of the walls and a short distance along either side of each wall. Intermediate welds are provided as indicated at 73, and V-shaped welds 74 secure the innermost end portions of the walls 51 and extend around the angle or bevel 53. The overlapping flat bars 75 are welded to each other in a uniform manner from above and below the layers of

overlapping bars. Welds **78** connect the outermost edges **76** of the flat bars **75** to the upper surfaces of the flat bars **70** adjacent to their outermost edges **71**. It will be noted that the welds **78** also extend around one corner of each bar **75** and partway along one side edge. The welds **78** also extend around the opposite corners of the underlying, associated flat bars **70** whereby an edge portion of each said flat bar **70** is welded to the lower surface of the associated bar **75**. In the area where the larger, outer ends of the bars **70** and **75** overlap, substantially long overlapping edge portions are provided with discontinuous or broken welds as indicated by the short weld portions **78'** spaced inwardly from the inner ends of the welds **78**. In the areas where the intermediate portions of the bar **75** overlap intermediate portions of the bars **70**, said overlapping bars are similarly welded from both above and below by intermediate welds **79**. Where the innermost ends of the bars **75** overlap the innermost ends of the bars **70**, the bars are firmly anchored together by welds **80** on both the upper surfaces of the bars **70** and the lower surfaces of the bars **75**. Thus it will be seen that all of the bars **70** and **75** are firmly and rigidly secured together and to the flow dividers **50**, and that in each instance where long, overlapping edge portions are welded to another member, a discontinuous weld connecting the members at separated areas is used to allow for different amounts of expansion and contraction of the different members. Allowing for relative expansion and contraction of the parts is important to prevent distortion of the diffuser in use and is necessitated, in part, by the various metal thicknesses and masses of the different parts. For example, the bars **75** are preferably of thinner material than the bars **70** which in turn are less massive than the stock used to form the flow dividers **50**.

It will be noted that in four circumferentially evenly spaced flow dividers **50** there are provided modified walls **52**, said modified walls being indicated at **52'**. The walls **52'** differ from the walls **52** in that they extend outwardly beyond the outermost edges **71** of the flat bars **70** and are provided with curved upper edge surfaces **81** which curve downwardly and outwardly as best seen in FIGS. 3 and 4. The curved surfaces **81** provide means for guiding the inner cover **34** into a substantially concentric position with respect to the stack of coils **32**.

A fan guard **90** is carried over the centrifugal blower **29** for protecting said blower from the load carried by the support diffuser **30**. Said guard comprises an outer ring **91** having outwardly projecting teeth **92** so shaped and angled that they are adapted to project between the inner ends of the bars **75** and rest upon portions of the bars **70** which they overlap. Thus the guard is supported at a plurality of points above the centrifugal blower **29**. Said guard also has an inner protective ring **93** integrally connected with the outer ring **91** by means of braces **94**.

The teeth **92** of the blower guard **90** are not secured to the bars **70** but merely rest thereon whereby said guard can be readily lifted out to facilitate removal, repair, and inspection of the blower. The teeth **92** stabilize and prevent distortion of the inner ends of the bars **75** and generally lock those parts associated with the center of the load support into position. The radially disposed braces **94** prevent the inner wraps or coil tails from being drawn downwardly into the blower. It will also be noted that the teeth **92** and ring **91** block the upper part of the passages between the bars **75**. This prevents the flow which is being forced radially outwardly by the blower from short circuiting; that is, immediately re-entering the blower adjacent to its upper end due to the substantial negative pressure present at the top of the blower. By blocking reverse flow at this point, better and more efficient circulation is achieved.

FIG. 6 shows the manner in which the walls **51** and **52** of the flow divider **50** are welded to the circular base plate **43**. When the bars comprising the walls **51** and **52** are welded to the base plate, said base plate tends to bow upwardly at its outer edges in a slightly upwardly concave form. When such a diffuser is used to support a stack of coils **32**, the outer edges are pressed downwardly thereby creating substantial stresses at the welded connections. To offset this, the base plate **43** is placed upon a substantially heavier, relatively nonflexible backup plate **100** having a flat upper surface **101**. The inner peripheral edge portion around the central aperture **44** is blocked upwardly in any suitable manner such as by a plurality of small blocks **102**. The outer peripheral edge portion of said base plate **43** is then clamped tightly down against the upper surface **101** of the backup plate **100** by any suitable means such as C clamps **103**. With the base plate **43** held in this upwardly convex position, the bars forming the walls **51** and **52** of the flow divider **50** are welded to the base plate as indicated at the welds **55–57**. After all of the flow dividers **50** have been welded in place, the C clamps **103** are released whereby the base plate **43** springs back to its normal flat position. Thus when the bars **70** and **75** are welded in place to complete the diffuser, said diffuser can be loaded without creating additional stress to the welded connections.

As best shown in FIG. 2, the bars **70** and **75** are circumferentially spaced from each other whereby the atmosphere gas which flows outwardly through the gas flow passages **58** can also flow across the bottom edges of the coil wraps directly supported by the support diffuser **30**. Because of the negative pressure above the fan, a small amount of the outgoing air is drawn back between the bars **75** of the top layer thereby inducing a turbulence at the open areas and between said bars **75** which improves the heating or cooling of the coils. As hereinbefore noted, the atmosphere gas cannot return all the way back to the fan due to the ring **91** of the fan guard **90**.

By placing the flow dividers directly and completely underneath the first layer of bars **70**, the entire load carrying capacity of the diffuser is enhanced and this is particularly true at the inner ends of said bars **70** and **75**. The inner tips of the walls **51**, beveled at **53**, are preferably substantially sharp whereby the air can escape the fan with the least amount of restriction. It is possible to make this edge quite sharp by use of the short bevel **53** without sacrificing substained strength at the iner ends of the bars **70** and **75**. The gas flow passages **58** widen slightly toward their outer ends whereby to eliminate any restriction of the fan's flow of gas and to maintain the velocity of the gas emitting from the fan or blower **29**.

The interconnection of each bar **75** with at least three of the bars **70** in effect ties each flow divider **50** with at least four other flow dividers thereby providing a structure of great strength which effectively resists warping and twisting when subjected to exterior pressures and substantial temperature changes. The bars **75** also provide sufficient load bearing areas to prevent damage to the edges of the coil wraps. By preventing warpage, the upper surfaces of the bars remain level thereby maintaining a maximum area of contact with the coil wraps for efficient heating by conduction.

It will be further understood that many changes in the details of the invention as herein described and illustrated may be made without, however, departing from the spirit thereof or the scope of the appended claims.

I claim:

1. A load support diffuser for supporting stacked coils in an annealing furnace comprising a base plate having a vertical axis; said base plate comprising flat plate metal; a plurality of flow dividers carried on the upper surface of said base plate; said flow dividers comprising V-shaped members the apices of which project inwardly and define a central opening adapted to receive a blower; said V-shaped members being circumferentially spaced around said opening and being skewed with respect to true radii of said base plate in one circumferential direc-

tion; said flow dividers defining gas flow passages therebetween which are skewed in said one circumferential direction and are adapted to direct a flow of atmosphere gas outwardly for diffusing said gas within an annealing furnace; each said flow divided member having a flat support bar mounted horizontally thereon and disposed substantially parallel therewith whereby said support bars are skewed in the same manner and direction as said flow dividers; said support bars being circumferentially spaced from each other whereby said gas flow passages are open at the top; other flat, circumferentially spaced support bars overlying and secured to said first mentioned support bars; said other support bars being skewed in the opposite circumferential direction with respect to said first mentioned support bars whereby each said other support bar overlies a plurality of said first mentioned support bars, there being portions of said gas flow passages completely open at the top whereby atmosphere gas from said passages is adapted to flow upwardly directly against the end of a coil seated on said diffuser and into the spaces between said other support bars.

2. A load support diffuser as set forth in claim **1**: said V-shaped members being uniformly circumferentially spaced around said opening and being skewed with respect to true radii of said base plate in a uniform manner; and said first mentioned support bars and said other support bars being inwardly tapered and circumferentially uniformly spaced.

3. A load support diffuser as set forth in claim **1**: each said other support bar overlying three of said first mentioned support bars.

4. A load support diffuser as set forth in claim **1**: outwardly and upwardly angled, flat deflector plates disposed adjacent to the outer ends of said gas flow passages adapted to deflect the gas upwardly at the outer periphery of said load support diffuser; each said deflector having its inner, lowermost edge welded to said base plate and extending vertically substantially the height of said flow dividers; side edges of each said deflector plate being disposed closely adjacent and unattached with respect to flow dividers on either side thereof; a brace member disposed under each said deflector plate, said brace member having an angular portion welded to the lower side of the deflector plate and being welded to the base plate to support the deflector plate free of said adjacent flow dividers.

5. A load support diffuser as set forth in claim **1**: the apex of each said flow divider terminating in a substantially sharp, vertical edge whereby to reduce the restriction of gas emitted by the blower.

6. A load support diffuser as set forth in claim **5**: each said flow divider comprising a pair of straight, inwardly converging walls, one of said walls projecting inwardly beyond the other said wall; said one wall having a short bevel at the inner end thereof, said bevel being in a vertical plane and converging with one side of said one wall to form said substantially sharp, vertical edge.

7. A load support diffuser as set forth in claim **6**: said walls being welded along the upper and lower edges thereof to said first mentioned support bars and said base plate, respectively, and certain long, overlapping portions of said first mentioned support bars and said other support bars being welded, by discontinuous welds whereby substantial portions of the overlapping parts are free to move with respect to each other to allow for separate expansion and contraction of said walls and support bars.

8. A load support diffuser as set forth in claim **1**: each said flow divider comprising a pair of straight, inwardly converging walls; certain of said flow dividers having one of said walls projecting outwardly a substantial distance beyond the other of said walls, the outwardly projecting portion having an outwardly and downwardly curved outer end, there being a plurality of said projecting walls circumferentially spaced around said diffuser and adapted to cooperate in guiding a cylindrical cover into a substantially concentric position with respect to said diffuser.

9. A load support diffuser as set forth in claim **1**: said flow dividers defining gas flow passages which widen slightly toward the outer ends thereof to maintain the velocity of gas emitted from a blower.

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KENNETH W. SPRAGUE, Primary Examiner

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,716,223 Dated February 13, 1973

Inventor(s) Robert Lee Corbett, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page 1, column 1, lines 70 and 71 and column 2, lines 1 and 2 should be deleted and the following inserted therefor:

"The general object of the invention is to provide an improved load support diffuser for supporting a stack of coils in an annealing furnace and diffusing an atmosphere gas thereto."

Signed and sealed this 10th day of July 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

Rene Tegtmeyer
Acting Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334