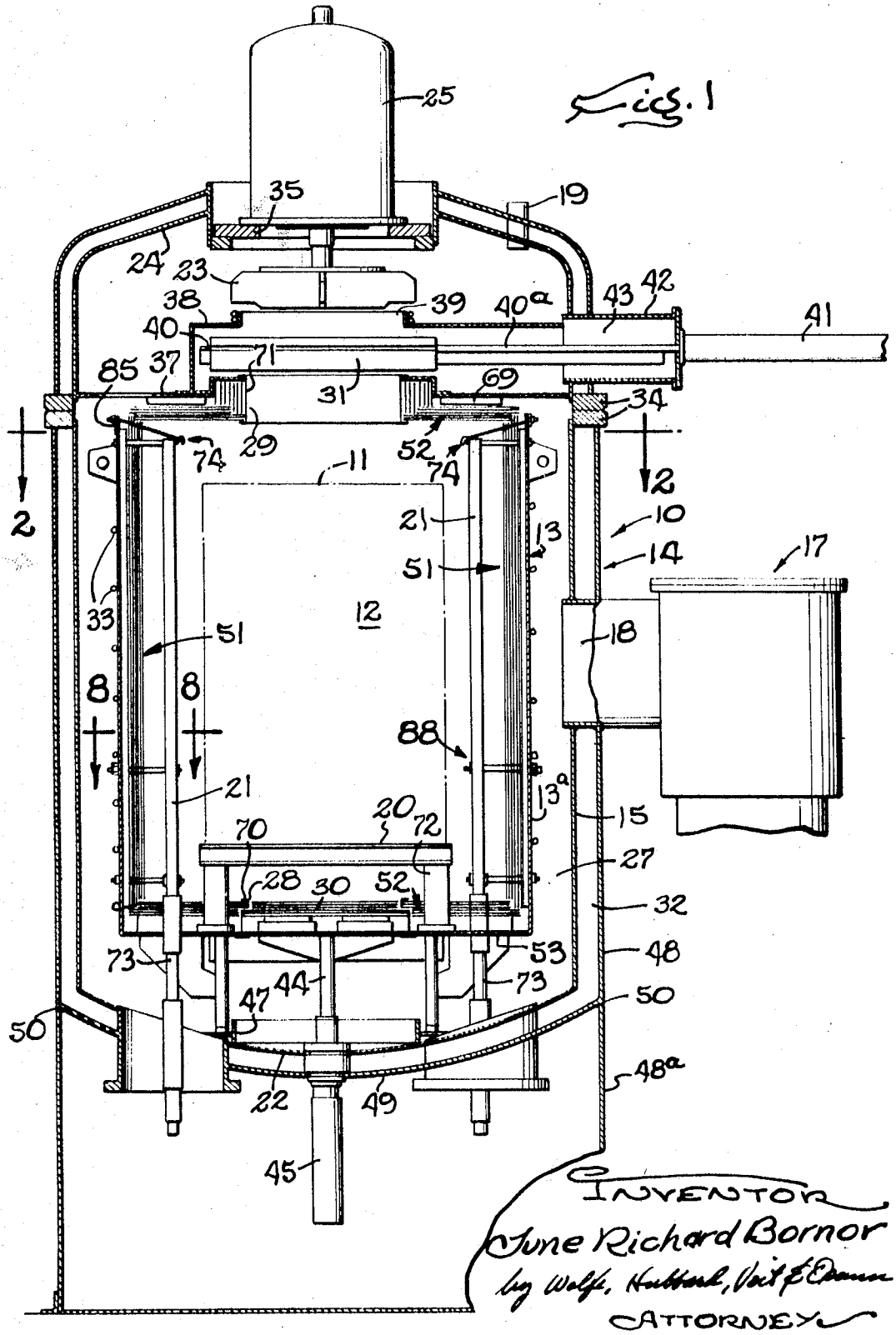
July 22, 1969 J. R. BORNOR 3,456,935

HEAT TREATING FURNACE WITH SHIELDING PACKS

Filed Sept. 20, 1967 4 Sheets-Sheet 1



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HEAT TREATING FURNACE WITH SHIELDING PACKS

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Fig. 2

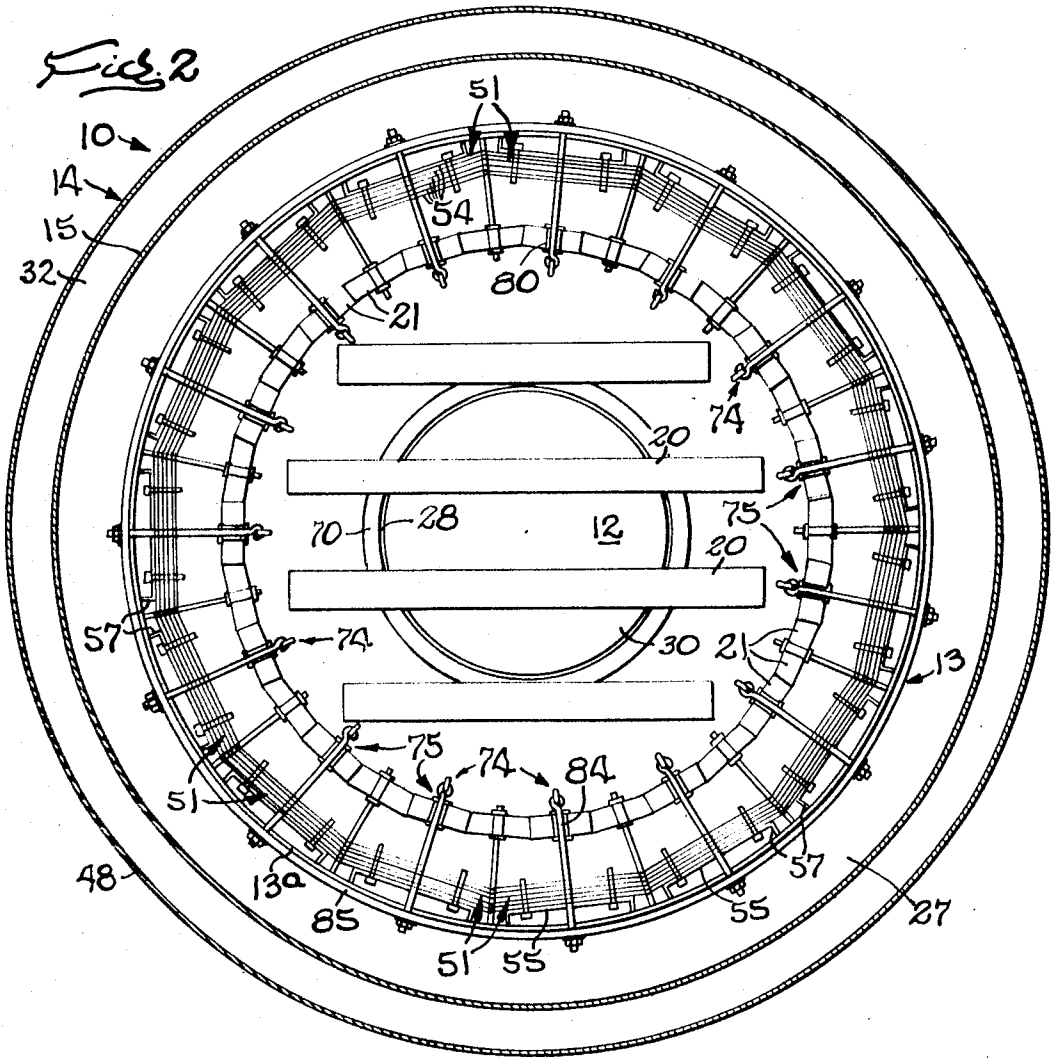
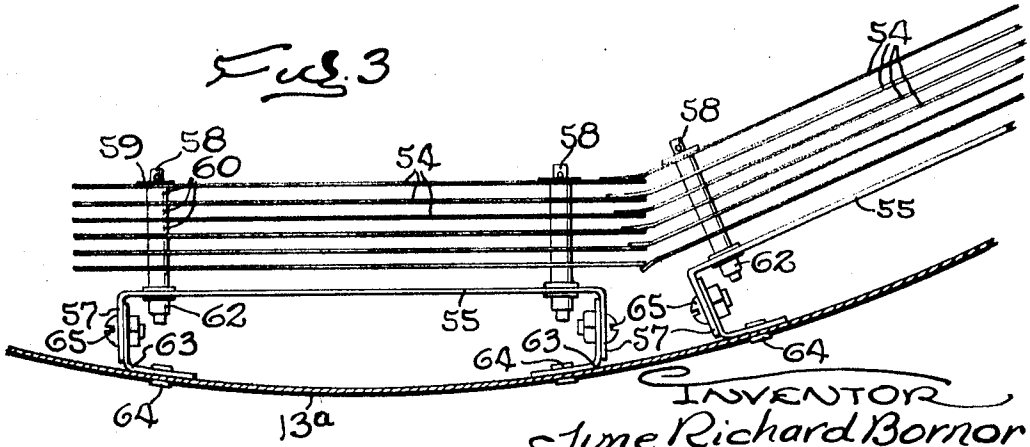


Fig. 3



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Fig. 4

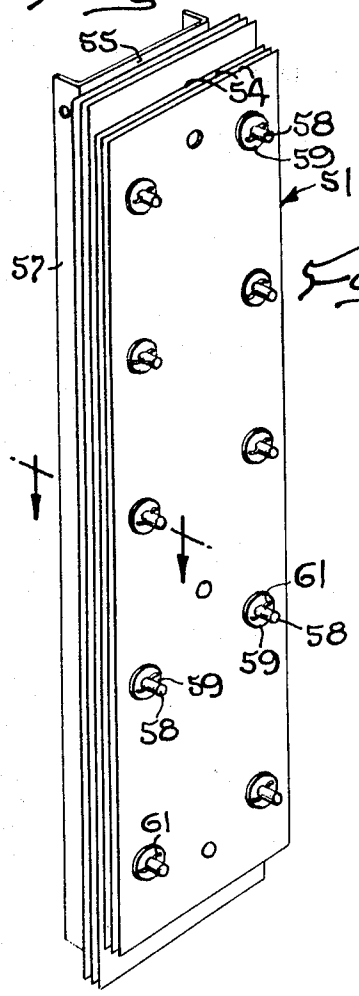


Fig. 5

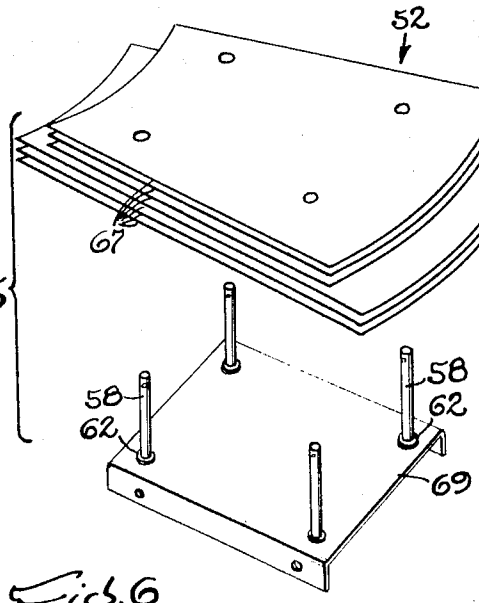


Fig. 6

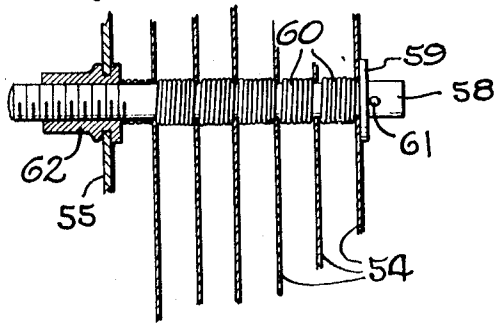
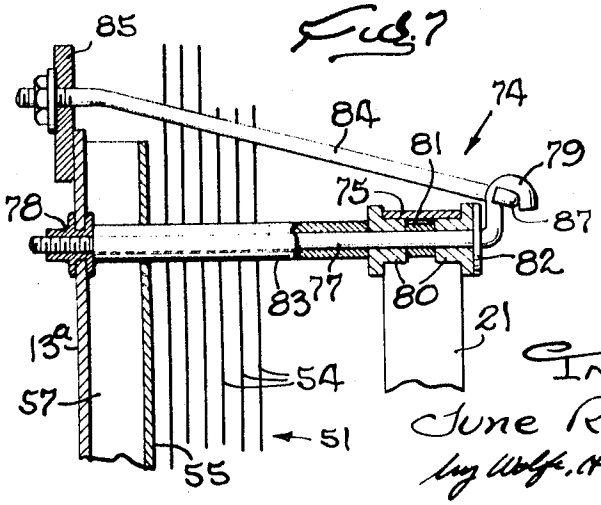


Fig. 7



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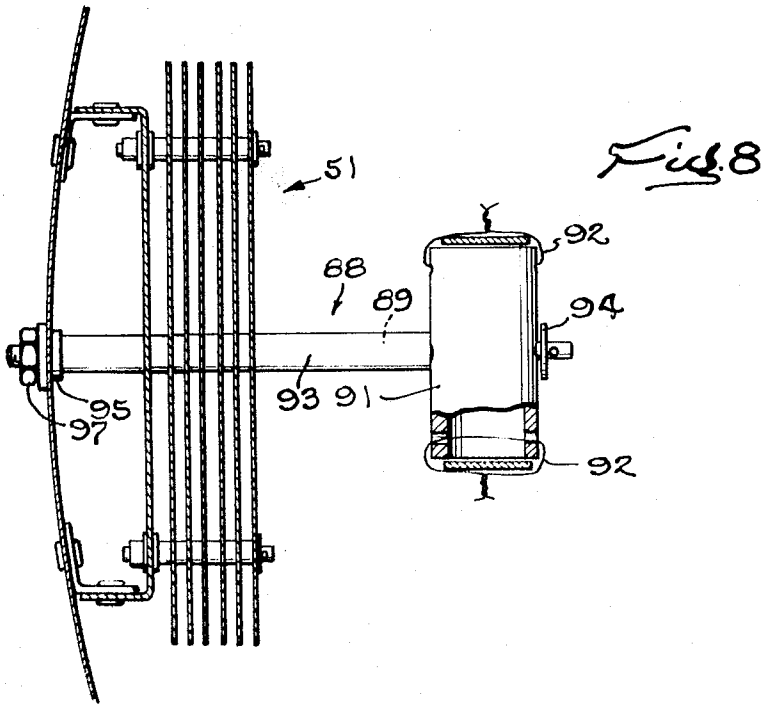
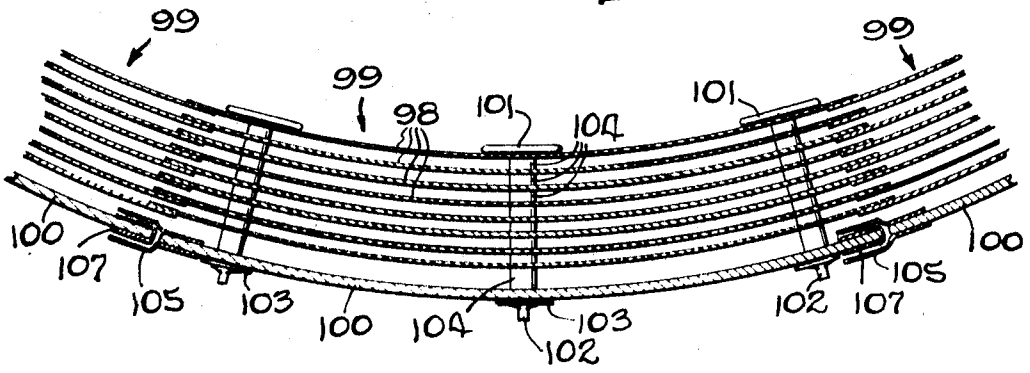


Fig. 8

Fig. 9



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3,456,935

HEAT TREATING FURNACE WITH SHIELDING PACKS

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Filed Sept. 20, 1967, Ser. No. 669,172
Int. Cl. F23m 9/00; F27d 21/00
U.S. Cl. 263—40 30 Claims

ABSTRACT OF THE DISCLOSURE

A vacuum heat treating furnace having a water-jacketed vacuum-tight vessel with a radiation-shielded inner enclosure defining a heating zone inside the enclosure and a cooling zone between the enclosure and the vessel. The enclosure is formed with inlet and outlet ports for the circulation of quenching gas by a fan outside the enclosure, and the radiation shielding is formed by independently removable shielding packs each having a series of spaced shields on a support constituting the outer member of the pack, the shields being carried on pins projecting inwardly through the shields with spacer sleeves between adjacent shields, and the spacers being coils of molybdenum wire. Rectangular packs shield the cylindrical sidewall of the enclosure, and packs in the form of segments of a circle form the end walls, the segments being truncated to define the ports. Movable reflectors close the ports during heating and are retracted during cooling, the heating being accomplished by ribbon elements extending zigzag fashion along the cylindrical wall and mounted on hangers extending through the shielding. In the alternate form, the rectangular supports and the shields are arcuately curved and interfitted together in self-sustaining cylindrical shape.

BACKGROUND OF THE INVENTION

This invention relates generally to heat treating furnaces and, more particularly, to vacuum furnaces for heating workpieces in a heating chamber or zone and subsequently cooling the workpieces by circulating a cooling gas through the zone and around the workpieces therein. Furnaces of this general type are disclosed in Ipsen Patent Nos. 3,301,541 and 3,219,331 wherein it will be seen that the basic furnace structure includes a vacuum-tight vessel with an internal enclosure defining the heating zone and forming a heat barrier for confining heat within the zone around the work therein. The enclosure is formed with ports for the circulation of cooling gas into and out of the zone, and a fan is provided, outside the enclosure, for drawing hot gas out of the chamber through one port and forcing it around the enclosure through a cooling zone and back to the other port for recirculation through the chamber. To limit loss of heat through the ports, the latter are covered during heating, either by fixed baffles or by movable reflectors, as disclosed in the aforesaid patents.

The invention has particular reference to the construction and support of the heat barrier in the vessel. The above patents utilize inner heat-resistant walls backed by conventional insulation, while others have suggested the use of spaced radiation shields encircling the heating zone to reflect the heat back toward the work. The problem with this type of barrier, however, is the difficulty and expense involved in the initial installation of the shields and the maintenance of the shields in service use, particularly when the shielding is composed of the thin foil that is preferred to reduce the amount of heat stored in the shielding.

SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a shielded heat treating furnace which overcomes the primary objections to prior shielded furnaces by greatly simplifying the installation and replacement of shielding in the furnace while providing an effective heat barrier in service use. A more specific object is to provide a novel type of shield pack that is relatively simple and inexpensive to construct, and to form the heat barrier within the furnace with a plurality of such packs arranged around the heating zone. Other objects are to construct and mount the packs for relatively quick and easy installation and removal, to shape and arrange the packs in a novel manner for use in a cylindrical furnace to cover not only the cylindrical wall but also the end walls, and to construct the packs as simply and inexpensively as is possible for independent handling as self-sustaining units. The invention also resides in the novel and simple manner of supporting the packs in the furnace for easy installation and removal.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a fragmentary cross-sectional view taken in a vertical plane through a heat treating furnace embodying the novel features of the present invention and showing the furnace in condition for a heating operation, the position of a work load being indicated in broken lines.

FIG. 2 is an enlarged cross-sectional view taken substantially along the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary view of part of FIG. 2, on a greatly enlarged scale, and showing the details of construction and mounting of the packs.

FIG. 4 is a perspective view of one of the shield packs used to cover the sidewall of the chamber.

FIG. 5 is an exploded perspective view of one of the packs used to cover an end wall of the chamber.

FIG. 6 is an enlarged fragmentary cross-sectional view taken substantially along the line 6—6 of FIG. 4, and showing details of support of the shields of a pack.

FIG. 7 is an enlarged cross-sectional view similar to part of FIG. 1.

FIG. 8 is an enlarged fragmentary cross-sectional view taken substantially along the line 8—8 of FIG. 1.

FIG. 9 is an enlarged fragmentary cross-sectional view generally similar to FIG. 3 and showing an alternate form of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings for purposes of illustration, the invention is embodied in a furnace **10** for heating workpieces **11** (FIG. 1) in a chamber or zone **12** defined by a cylindrical enclosure **13** oriented about a vertical axis and disposed within a vacuum-tight vessel **14** having a cylindrical inner wall **15**, and subsequently cooling or quenching the work in the heating chamber to obtain desired physical properties of the metal. To protect the finish of the workpieces, they are heated in a protective atmosphere such as a vacuum produced by a suitable pumping apparatus **17** that communicates with the interior of the vessel through a port **18**, and are quenched in a flow of non-oxidizing gas admitted into the vessel through a port **19** from a source such as a pressurized tank (not shown).

During treatment, workpieces are supported in a hearth **20** adjacent the lower end of the work chamber **12** and are surrounded by radiant heaters **21** connected through

the lower end wall **22** to a suitable electrical source and control. Cooling gas is circulated within the vessel upon completion of heating by a fan **23** disposed beneath the upper end wall **24** of the vessel and driven by a motor **25** outside the vessel. It will be seen in FIG. 1 that the cylindrical enclosure **13** includes a cylindrical shell **13a** supported in spaced relation with the vessel wall **15** to define a cooling zone **27** outside the enclosure, and that inlet and outlet ports **28** and **29** are formed in the end walls of the enclosure on opposite sides of the heating zone, the outlet port being immediately beneath the fan so that heated gas drawn out of the chamber by the fan is forced radially outwardly and then downwardly through the cooling zone and then is forced back into the chamber through the inlet port to flow through the chamber and around the work. Baffles or movable reflectors **30** and **31**, herein the latter, block heat radiation through the circulation ports during heating but permit gas circulation during quenching, as described in the aforesaid patents.

In this instance, the vessel **14** is surrounded by a water jacket **32** in which coolant is circulated during operation of the furnace, the inner cylindrical wall **15** thus constituting a cooling element as well as the outer wall of the interior of the furnace. Other cooling elements such as coils or fins in the cooling zone may be used to assist in cooling the circulating gas. Herein, the outside of the cylindrical enclosure **13** is wrapped with coolant-circulating tubes **33**. For access to the interior, the upper section of the vessel is removable, the two sections of the water jacket being separated by rings **34** which are clamped together when the furnace is closed. The fan motor **25** is mounted on a pad **35** recessed into the upper end wall **24** of the vessel, and the upper end wall of the enclosure **13** is supported on the upper section of the vessel for removal with the upper section, thus opening the enclosure for loading and unloading of workpieces as an incident to the opening of the vessel. For this purpose, the upper end wall is suspended from the top section of the vessel on a perforated wall **37** fastened to the top section.

The upper reflector **31** is a disk-shaped piece larger in diameter than the outlet port **29** and overlying the latter within a hood **38** having an outlet **39** adjacent the underside of the fan. Supporting the reflector disk is a horizontal track **40** and a rod **40a** which extends horizontally to the right, as viewed in FIG. 1, through the sidewall **15** of the vessel to a cylinder **41** for shifting the reflector into and out of its blocking position over the outlet port. The hood and a sealed extension casing **42** thereof define a chamber at **43** spaced to the right from the port for receiving the reflector in its out-of-the-way position in which the port is uncovered.

Similarly, the lower reflector **30** is a disk fitted upwardly into the inlet port **28** of the enclosure and movably supported on a vertical rod **44** extending downwardly through the lower end wall **22** of the vessel to a cylinder **45** for lowering the disk from the raised position shown in FIG. 1 to a lowered, out-of-the-way position adjacent a ring **47** on the lower end wall. Thus, both ports may be closed during heating and then opened wide for full circulation of cooling gas through the work chamber **12**. A downward extension **48a** of the outer cylindrical wall **48** of the water jacket forms a base for the furnace, the lower end of the water jacket being formed by a dished disk **49** sealed at **50** to the sidewall.

For optimum operating efficiency, a heat barrier is formed between the heating and cooling zones **12** and **27** to limit the escape of heat generated by the heaters **21**. This not only concentrates available heat on the work in the heating zone but also facilitates cooling of circulating gas in the cooling zone for more rapid quenching of the work. In prior practice, both insulated walls and groups of reflecting shields have been used for this purpose, with varying degrees of success and practicality in service use.

In accordance with the present invention, the heat barrier between the heating and cooling zones **12** and **27** is formed by a plurality of shielding packs **51** and **52** that are comparatively simple and inexpensive to construct and are arranged in groups covering the various walls of the heating zone, forming substantially continuous inner reflecting walls backed up by spaced reflecting walls each formed by several reflecting sheets of different shielding packs. The packs are supported in a novel manner in the furnace in edge-to-edge relation such that the barrier is as effective as that obtained with prior conventional shielding while the packs are much easier to work with, both during initial installation and during eventual maintenance of the furnace.

In this instance, the cylindrical shell **13a** has an open upper end covered by an annular upper wall of shielding defining the outlet port **29**, and has an apertured lower end wall **53** beneath an annular lower wall of shielding defining the inlet port **28**. The annular walls of shielding are formed by the packs **52** and the cylindrical sidewall is covered by the packs **51**. For this purpose, each of the packs **51** is of elongated rectangular shape, as shown most clearly on FIG. 4, and comprises several flat rectangular sheets **54** of reflecting material, for example, thin and flexible molybdenum foil, arranged in spaced, side-by-side relation alongside an elongated shape-retaining support in the form of a rectangular plate of channel-shaped cross-section having a flat body **55** parallel to the outer sheet of the pack and flanges **57** along its longitudinal margins extending outwardly away from the sheets.

The sheets **54** of each pack **51** are held on the associated support plate by a plurality of pins **58** fastened to the body **55** and extending inwardly therefrom through all of the sheets, and are maintained in properly spaced relation by means of washers **59** on the inner ends of the pins and spacer sleeves **60** (FIG. 6) of preselected length that are telescoped onto the pins between the sheets and abut against the latter around the holes through which the pins project. A lock wire **61** inside each washer holds the latter in place on the supporting pin, and a fastener **62** on the plate body cooperates with the outer spacer sleeve on each pin to hold the outer sheet **54** in properly spaced relation with the plate. As shown in FIG. 6, the fasteners herein are so-called rivnuts into which the pins are threaded, the rivnuts having heads disposed inside the plate, riveted shoulders outside the plate and tapped center bores into which the pins are threaded.

In the illustrative packs **51**, five vertically spaced pairs of pins **58** are provided on each support plate with the pins of each pair positioned adjacent the opposite longitudinal edges of the sheets. The packs are somewhat shorter than the length of the shell sidewall **13a**, covering the latter completely between the upper and lower shielding walls, and are of preselected width such that a predetermined number of packs may be arranged edge-to-edge as shown in FIG. 2 to surround the chamber **12** with a heat barrier of polygonal cross-sectional shape. Of course, the shape, length and width of the packs may be varied to suit different sizes and shapes of heating chambers and, while flat sheets are easiest to work with, other shapes may be used. At least the inner sheets of the pack should be capable of withstanding the maximum operating temperatures to be used, but the outer sheet or sheets and the support plate, being protected by the inner sheets, may be composed of materials such as stainless steel suited for lower temperatures.

To support the packs **51** inside the cylindrical shell **13a**, brackets **63** (FIG. 3) in the form of L-shaped plates are arranged in pairs and fastened to the shell as by rivets **64** with the free legs of the brackets in each pair projecting inwardly, parallel to each other and spaced to lie alongside the flanges **57** of a support plate, herein between the flanges. Bolts **65** fasten each pack removably to a pair of brackets adjacent the upper end of the shell where the bolts are easily accessible for installation during

assembly and also for removal during later maintenance. Similar brackets (not shown) below the upper pair guide or brace the lower portion of the pack to hold it in an upright position along the cylindrical shell wall.

Initially, the pairs of brackets **63** are spaced according to the width of the packs **51** and a full set of packs is installed simply by positioning each pack along the wall and over the brackets and bolting the upper ends of the brackets. If, in service use, it should become necessary to remove a pack for repair or replacement, the old pack is unfastened and pulled endwise out of the shell and the replacement is slid endwise into the vacated space and bolted in place. Supported in this manner, the packs are free to grow and contract in length during heating and cooling.

As shown in FIGS. 2 and 3, at least the inner sheets **54**, and preferably all of the sheets, overlap the corresponding sheets of the packs on each side. Herein, all of the sheets are overlapped and, due to the angular relationship of adjacent packs, the inner sheets overlap each other to a greater extent than the outer sheets. With this progressive overlap all the sheets in each pack may be the same size for ease in construction.

To complete the reflecting heat barrier around the heating zone **12**, the upper and lower walls of the enclosure **13** are formed as rings by two groups of shielding packs **52** which are generally in the shape of truncated sections of a circle, as shown most clearly in FIG. 5, each having several sheets **67** of reflecting material supported in spaced side-by-side relation on pins **58** on a channel-shaped plate **69**. As in the packs **51**, the pins are mounted on the support plate by means of rivnuts **62** and carry spacer sleeves **60** holding the sheets in properly spaced relation. The structure shown in FIG. 6 applies equally to both types of packs.

The arcuately curved inside edges of the sheets **67** define the ports **29** and **30** and the outside edge portions overlie the upper and lower edges of the sheets **54** of the packs **51** to eliminate straight-line paths through the barrier where the two types of packs come together, the various edges preferably being staggered as shown in FIGS. 1, 4 and 5. When light and freely flexible foil sheets are used, the edges of the sheets at the ports preferably are capped with flanged rings **70** and **71**, as shown in FIG. 1, to prevent fluttering of, and possible damage to the sheets during gas circulation. The support plates of the lower reflecting wall of the enclosure are attached to the lower end wall **53** of the shell, and the supports of the upper reflecting wall are bolted to brackets on the wall **37** and thus are mounted for movement with the upper section of the vessel. Each of the reflecting disks **30** and **31** is formed as a series of spaced shields suitably mounted for movement as a unit by the cylinder **41** or **45**. If foil sheets are used, the edges of these sheets are capped to reinforce the sheets around the peripheries of the disks.

As will be seen in FIG. 1, the hearth **20** is formed by horizontal bars supported on posts **72** upstanding from the end wall **53** of the shell through holes in the sheets of the lower shielding packs **52**, and the circuits for the heating elements **21** include leads **73** entering through the lower end of the vessel and extending into the heating zone through the end wall of the shell and the packs **52**. The holes in the packs **52** may be performed in appropriate locations for the various elements that project into the heating chamber through the shielding.

Herein, the heating elements **21** are upright portions of one or more elongated ribbons of suitable resistance-heating material connected to the leads **73** and extending zigzag fashion up and down along the inner reflecting wall formed by the inner sheets of the packs **51**. Each ribbon extends upwardly along the reflecting wall parallel to the latter as shown in FIG. 1, then passes over a hanger **74** as shown at **75** (FIG. 7) adjacent the upper end of the pack, and then extends vertically back down along the reflecting wall to a level near the lower end of the pack, crossing over to the next upwardly extending portion in front of the next pack **51**. The hangers **74** comprise rods **77** (FIG. 7) threaded into rivnuts **78** anchored in the sidewall **13a** of the shell and projecting inwardly through the shielding packs to upwardly extending, downwardly hooked inner end portions **79** spaced inwardly from the heating elements. The ribbon position **75** passes over an insulating ceramic spool telescoped onto each hanger rod adjacent the hook **79**, the spool comprising two flanged end pieces **80** separated by a spacer **81** and being held on the hanger rod between a retaining plate **82** and an elongated insulating sleeve **83** covering the hanger rod between the spool and the shell. A brace **84** is fastened to ring **85** on the upper end of the shell sidewall above the pack and extends downwardly and inwardly to the inner end of the hanger rod with a hook **87** interfitting with the hook **79** to brace the hanger against sagging, in the manner of a guy wire.

The lower portions of the heating elements **21** are braced laterally by lower hangers **88** (FIG. 8) disposed between adjacent packs **51** and including rods **89** secured to the shell sidewall and extending inwardly through the shielding with insulating tubes **91** on their inner ends abutting against the adjacent sides of two heating elements. Wires **92** hold the elements adjacent the tube ends, and a ceramic sleeve **93** covers the rod and holds the tube against a washer **94** to maintain the spacing of the heating elements from the inner sheet of shielding. The outer end portions of rods **89** extend loosely through flanged sleeves **95** fitted in the sidewall **13a** and are held in place by bolts **97**, which can be removed from outside the shell to release the hanger. In this manner, the heating elements **21** are supported securely on the shell and maintained in properly spaced relation with the shielding.

Although the lower hangers **88** extend through the portion of the shielding where the sheets **54** of adjacent packs **51** overlap, it is preferred to provide preformed holes for the hangers. Similarly, holes are preformed for the upper hangers **74** adjacent the upper ends of the packs. The brace rods **84** may extend through the overlapped joints between the packs **51** and the upper packs **52**.

DESCRIPTION OF ALTERNATE FORM, FIG. 9

Shown in FIG. 9 is a modified form of the invention in which the sheets **98** of the shield packs **99** are curved to follow the curvature of a cylindrical vessel inside the latter. In this instance, the sheets of each pack are mounted on a curved support plate **100** by means of so-called pigtail hanger pins having integral loops **101** on their inner ends abutting against the inner sheet of the pack with shanks **102** extending outwardly through aligned holes in the the sheets and the support plate. Push nuts **103** on the outer ends of the pins hold the latter in place, and spacer sleeves **104** between the layers of shielding, and between the outer sheet and the support plate, maintain the spacing of the sheets.

Again, the sheets of adjacent shielding packs overlap to form a complete reflecting barrier. It will be seen that the supports and sheets of these packs have rectangular outside shapes, and that the sheets and the supports are concentrically curved to form sections of cylinders.

Another modification in FIG. 9 is the manner of holding the support plates **100** relative to each other. Instead of fastening the plates to an outer shell member, the plates are formed with interfitting elements **105** and **107** along adjacent side edges for coupling adjacent packs **99** releasably to each other whereby the supports themselves form a cylindrical shell. Herein, the elements **105** are laterally opening, U-shaped channels secured to corresponding edges of the packs, the right-hand edges as viewed in FIG. 9, to receive and interlock with edging strips **107** on the left-hand edges of the adjacent packs, the edging strips being clamped around the left edge portions. With this arrangement, the packs are fitted together

in edge-to-edge relation with the shielding sheets 98 overlapping each other, and are self-sustaining in a cylindrical shape. At the same time, any pack or packs may be withdrawn endwise from the cylinder and replaced in generally the same manner as in the first embodiment.

From the foregoing, it will be seen that the present invention overcomes the primary disadvantages of prior shielded furnaces by providing easy-to-construct packs of shielding that may be fitted together to make a complete heat barrier, and that are independently separable from the remainder for repair or replacement. Accordingly, individual reflecting walls of different shapes and sizes may be constructed by arranging a plurality of packs of preselected size and shape in the particular shape of wall that is needed, and holding the packs in the desired shape in a manner that facilitates removal of any selected pack or packs for servicing.

I claim as my invention:

1. In a heat treating furnace, the combination of, a vacuum-tight outer vessel; a cylindrical shell inside said vessel surrounding a heating zone inside said shell; means supporting said shell in spaced relation with the vessel; a series of first independently separable shielding packs arranged around and covering the inner side of said shell, each of said packs comprising a plurality of generally rectangular heat-resistant reflecting sheets spaced apart in side-by-side relation, a support between the outer sheet of each pack and said shell, a plurality of pins on said support extending inwardly therefrom through said sheets, and spacing means on said pins maintaining said sheets in spaced relation with each other and with said support; means releasably securing each of said supports to said shell and thereby mounting said packs on the shell whereby each said pack may be independently installed and removed, said packs being mounted in edge-to-edge relation to form a generally cylindrical heat barrier inside said shell; second shielding packs forming end walls disposed across the ends of said heating zone and having central openings for the circulation of gas through the zone, said second shielding packs similarly comprising a plurality of heat-resistant reflecting sheets spaced apart in side-by-side relation, a support between the outer sheet of each pack and the adjacent end of said vessel, pins on said support extending inwardly through the sheets, and spacing means on said pins maintaining said sheets in spaced relation; means securing the supports of said second packs in place with the shields thereof in edge-to-edge relation with said first packs, whereby said first and second packs subsentially enclose said heating zone; and means in said zone for heating workpieces.

2. The combination defined in claim 1 in which each of said end walls comprises a plurality of second packs constituting parts of a ring, the reflecting sheets of each of said second packs being in the shape of truncated rectors of a circle with outside edges in overlapping relation with the end edges of said rectangular sheets and with inside edges at said openings, the securing means for said second packs including members extending across both ends of said shell outside said end walls.

3. The combination defined in claim 1 in which the sheets of said first packs are subsentially flat and extend along chords of said shell, forming said barrier with a polygonal cross-section to surround said heating zone.

4. The combination defined in claim 3 in which each of the supports of said first packs is a rectangular plate of channel-shaped cross-section having a body lying alongside the outer sheet of the package and flanges projecting outwardly toward said shell, said securing means comprising brackets fastened to said shell and to said flanges.

5. The combination defined in claim 4 in which said brackets are arranged in planes parallel to said flanges and are spaced apart to abut against the sides of the flanges.

6. The combination defined in claim 1 in which said spacing means comprise a series of spacer sleeves telescoped onto said pins and disposed between adjacent

sheets thereon in abutting engagement with the sheets, and abutments on the inner ends of said pins retaining the inner reflecting sheets thereon, said sleeves being composed of heat-resistant wire wound into helical coils.

7. The combination defined in claim 1 in which said first packs are positioned with the reflecting sheets thereof overlapping the sheets of the adjacent first packs on both sides.

8. In a heat treating furnace of the type having an outer wall, an inner heating zone, means in said zone for heating workpieces to be treated, and a heat barrier between said outer wall and said heating means, the improvement comprising a plurality of independently separable shielding packs arranged around said heating zone to form said barrier, each of said packs comprising a plurality of sheets of heat resistant reflecting material in spaced apart, side-by-side relation, an outer support for each pack disposed alongside the outer one of said sheets, pins mounted on said support and extending inwardly through said sheets, and spacing means on said pins maintaining said sheets in spaced relation with each other; and means for mounting said supports in said furnace, said packs being disposed in edge-to-edge relation to surround said zone with the inner sheets of the packs forming a substantially continuous reflecting wall defining the sides of said zone and said packs being removable and replaceable independently of each other.

9. The improvement defined in claim 8 in which said spacing means comprise a series of spacer sleeves telescoped onto each pin and disposed between adjacent sheets thereon in abutting engagement with the sheets, and an abutment on the inner end of each pin retaining the inner sheet thereon, each of said sleeves being composed of heat-resistant wire wound into a helical coil.

10. The improvement defined in claim 8 in which each of said supports is a plate of channel-shaped cross-section having a body lying alongside said outer sheet and flanges projecting outwardly toward said outer wall, said mounting means including brackets releasably secured to said flanges.

11. The improvement defined in claim 8 in which said packs are positioned with each inner sheet of each pack overlapping the sheets of the adjacent packs on both sides.

12. The improvement defined in claim 8 in which the supports for a group of said packs are generally rectangular plates and are arcuately curved to form sections of a cylinder, the sheets of said group of packs being concentrically curved and said group of packs being arranged in a cylindrical heat barrier surrounding said zone.

13. The improvement defined in claim 12 further including interfitting elements on the adjacent edges of said curved supports joining adjacent supports together in a selfsustaining cylindrical shell.

14. The improvement defined in claim 13 in which said interfitting elements include laterally opening channels on corresponding edges of said curved supports receiving the edge portions of the adjacent curved supports.

15. A heat treating furnace having a heating chamber defined by a walled enclosure formed at least in part by a plurality of shield packs of preselected size and shape arranged in edge-to-edge relation to form a wall of said chamber, each of said packs constituting an independently separable unit having an outer support, a series of reflecting shields arranged in spaced side-by-side relation, and means mounting said shields on the inner side of said support for installation in and removal from said furnace with said support independently of the other said packs.

16. A heat treating furnace as defined by claim 15 in which at least part of said packs are generally rectangular in shape.

17. A heat treating furnace as defined by claim 15 in which at least part of said packs are in the shape of segments of a circle and are arranged in a common plane to form a circular wall.

18. A heat treating furnace as defined by claim 15 in which part said packs are generally rectangular in shape and are arranged around said chamber in a generally cylindrical group, and other packs are in the shape of segments of a circle and are arranged in circular groups across the ends of said cylindrical group.

19. A heat treating furnace as defined by claim 18 further including heating means in said heating chamber including elongated heating elements spaced inwardly from said rectangular packs and parallel thereto, and means extending through said cylindrical group and supporting said elements in said chamber.

20. A heat treating furnace as defined by claim 18 in which said cylindrical group is oriented about a vertical axis, and said supporting means include first hangers extending through the upper end portions of the rectangular packs and connected to the upper end portions of said elements, and second hangers below the level of said first hangers bracing the lower portions of said elements.

21. A heat treating furnace as defined by claim 20 in which said supporting means also include braces secured at their outer ends to portions of said furnace outside said cylindrical group, said braces extending inwardly and downwardly to the inner ends of said first hangers to secure the latter against sagging.

22. A heat treating furnace as defined by claim 20 in which said heating elements are upright portions of at least one ribbon of resistance heating material extending zigzag fashion up and down along and around said cylindrical group of packs, said first hangers being disposed between the upper portions of two elements to provide vertical support and said second hangers being disposed between the lower portions of two adjacent elements to provide lateral support.

23. A heat treating furnace as defined by claim 15 in which said shields are composed of thin and flexible metal foil and said support is a shape-retaining plate, said shields being held generally in the shape of said plate by mounting means including pins on said support extending through the shields, spacers on said pins between adjacent shields, and abutments on the inner ends of the pins holding the inner shields in place.

24. A heat treating furnace as defined in claim 23 in which said shields and said supports are flat rectangular parts.

25. A heat treating furnace as defined in claim 23 in which said supports and said shields are arcuately and concentrically curved whereby said packs constitute sections of a cylinder.

26. A heat treating furnace as defined in claim 23 in which said curved supports are arranged and joined to form a cylindrical shell, each support being removed independently of the others from said shell.

27. A heat treating furnace as defined in claim 23 in which said spacers are helical coils of heat-resistant wire.

28. For use as part of a wall of a heat barrier in a heat treating furnace, a radiant shielding pack comprising a series of reflecting shields of preselected shape disposed in spaced, side-by-side relation, said shields being sheets of thin and flexible heat-resistant foil, a support of shape-retaining material disposed alongside said series of shields, pins on said support extending through said shields, and means on said pins maintaining said sheets in properly spaced relation with each other and with said support for installation in and removal from the furnace as a unit.

29. A heat treating furnace as defined in claim 18 in which said reflecting sheets are sheets of thin and flexible heat-resistant foil and the sheets of one of said packs are in flexible overlapping engagement with the sheets of the adjacent packs on both sides so that the inner sheets overlap each other to a greater extent than the outer sheets whereby the sheets may be of uniform size for ease of construction.

30. A heat treating furnace as defined in claim 3 in which said reflecting sheets are sheets of thin and flexible heat-resistant foil and the sheets of one of said packs are in flexible overlapping engagement with the sheets of the adjacent packs on both sides so that the inner sheets overlap each other to a greater extent than the outer sheets whereby the sheets may be of uniform size for ease of construction.

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