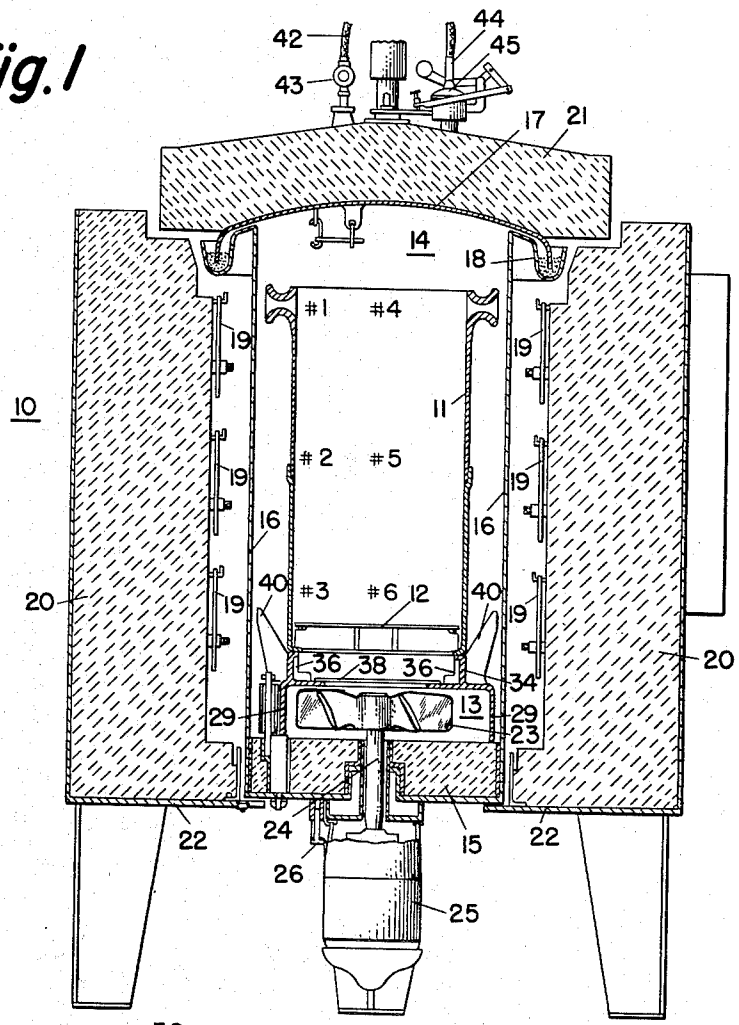
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HEAT-TREATING FURNACE

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Fig. 1



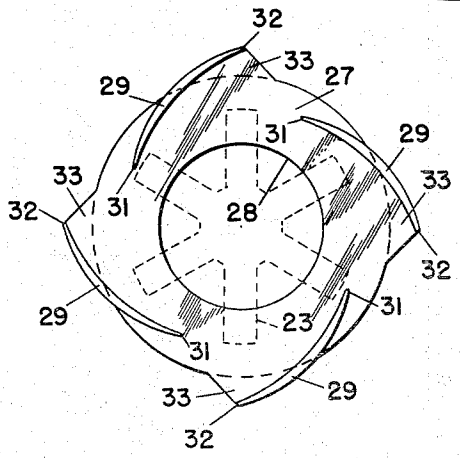


Fig. 2

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Fig. 3

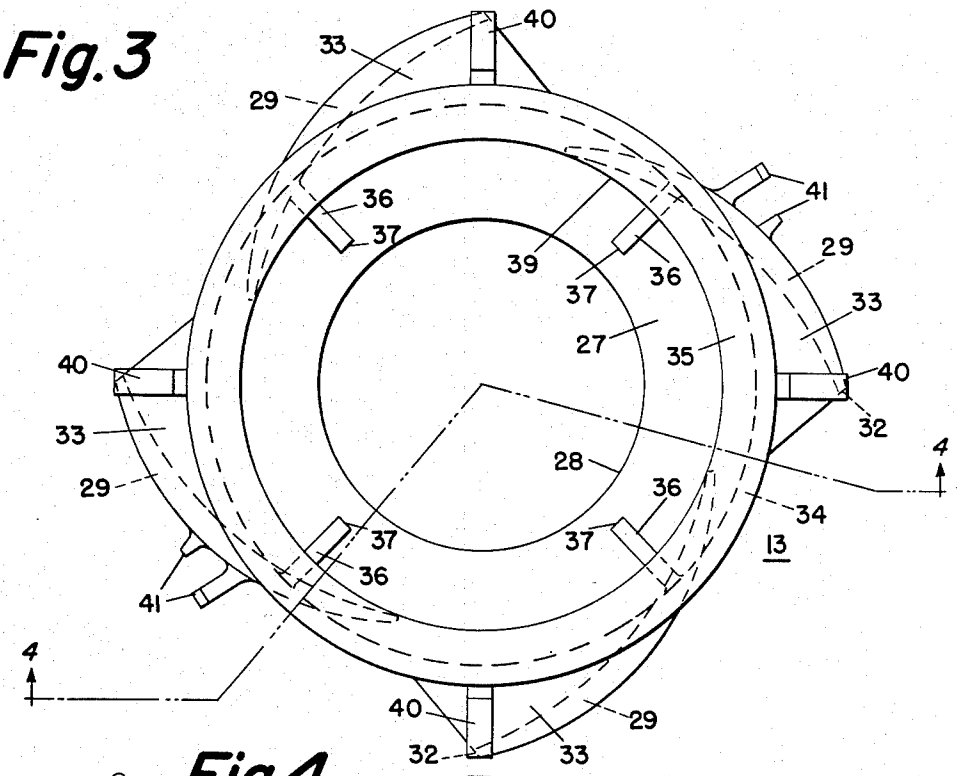
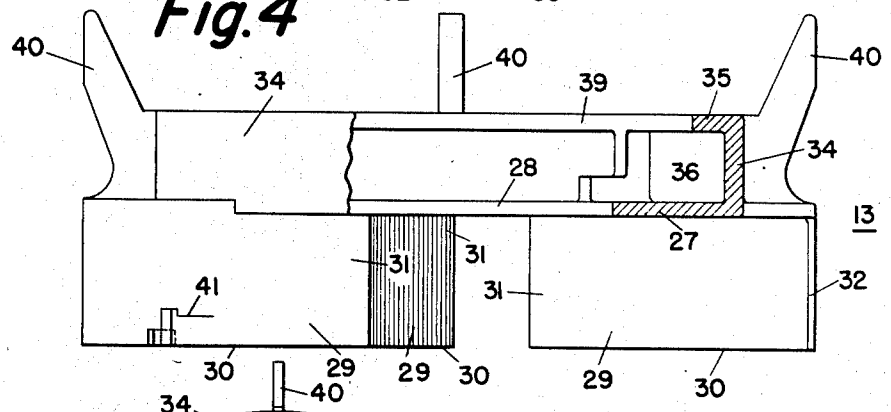


Fig. 4



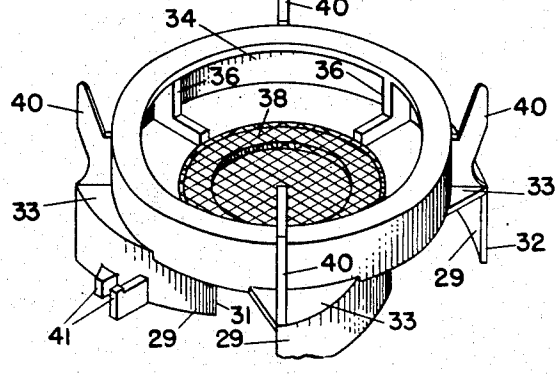


Fig. 5

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Fig. 6A

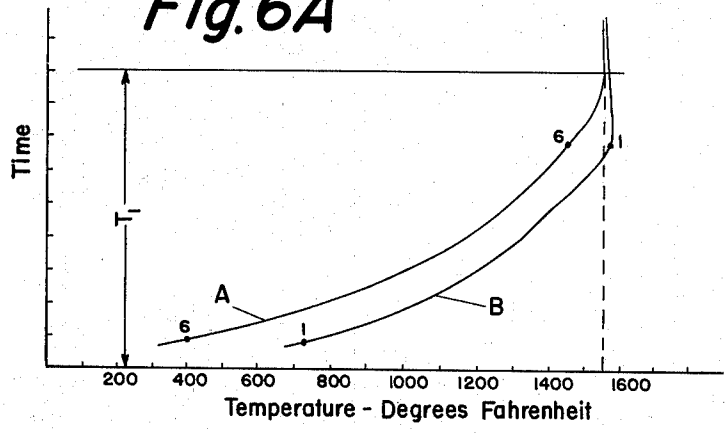
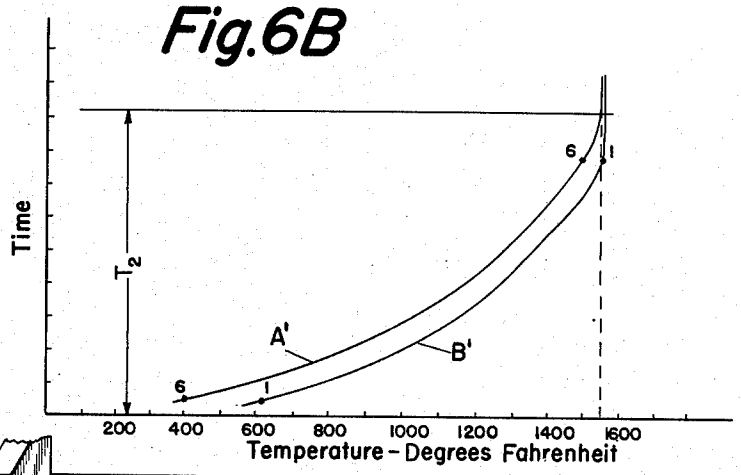


Fig. 6B



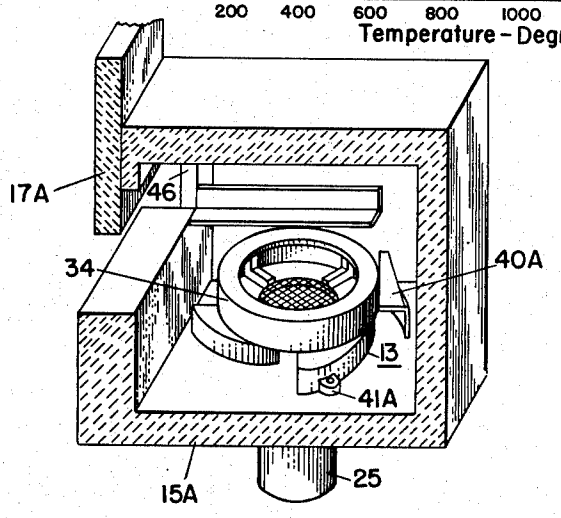


Fig. 7

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2,686,665

HEAT-TREATING FURNACE

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Application October 14, 1950, Serial No. 190,152

3 Claims. (Cl. 266—5)

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This invention relates to heat-treating furnaces of the forced convection type used for tempering, annealing, carburizing, nitriding and similar heat-treating processes.

In many furnaces of this type, a fan, disposed in the bottom of the furnace below an open-ended basket which contains the work to be treated, forcibly circulates the furnace atmosphere repeatedly through the work container and a heating space between the work container and the internal wall of the furnace.

In accordance with the present invention, enclosure of the fan and support of the work container is provided by a casing structure essentially comprising an apertured plate forming the upper wall of a fan housing and from which downwardly extend a plurality of vanes whose lower edges rest upon the furnace base, thus to form fan discharge outlets or ducts opening into the heating space of the furnace. Further and more specifically in accordance with the invention, a peripherally continuous sealing skirt extends upwardly from the apertured plate with its upper portion forming a supporting ring or flange for the bottom of the work basket or tray. More particularly, a removable screen passed by the sealing skirt overlies the fan inlet opening or openings in the apertured plate and is preferably positioned by bracing ribs of the sealing skirt.

Further in accordance with the invention, the fan outlet vanes extend beyond the sealing skirt with the upper edges of the vane extensions respectively joined to projecting areas of the apertured plate.

Further in accordance with the invention, the fan housing is provided with members extending upwardly from it to center the work container supported thereon with respect to the sealing skirt and fan inlet; more specifically, the lower and vertical portions of the center members respectively merge with the apertured plate and with the sealing skirt to impart additional strength and rigidity to the entire unit.

The invention further resides in novel and useful features of construction, combination and arrangement.

For a more detailed understanding of the invention and for illustration of the embodiments thereof, reference is made to the accompanying drawings, in which:

Fig. 1 is a side elevational view, in section, of one type of furnace utilizing the new fan housing and work support unit;

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Fig. 2 is a bottom view of the fan housing unit of Fig. 1;

Fig. 3 is a top plan view, on enlarged scale, of the fan housing structure of Fig. 2;

Fig. 4 is an elevational view, partly in section, of the housing shown in Fig. 3;

Fig. 5 is a perspective view of the fan housing of Figs. 2–4;

Figs. 6A and 6B are explanatory figures referred to in discussion of a furnace embodying the new fan housing; and

Fig. 7 is a perspective view, partly broken away, of another type of furnace utilizing the housing structure of Figs. 1–5.

In Fig. 1 there is shown a heat-treating furnace 10 of type generally shown in United States Letters Patent including 2,176,473; 2,168,028; 2,161,162; 2,032,209; 1,999,757; 1,926,234; 1,949,716; 1,940,948; and 1,721,840. In brief, the work to be treated is disposed in a work continer 11 whose upper and lower ends are open and whose sidewalls are imperforate. The grid 12 in the bottom of the work basket, tray or equivalent container 11 provides support for the work pieces and yet permits free passage of the furnace atmosphere. As later more fully discussed, the work container rests upon and is supported by a fan housing structure 13 disposed in the bottom of the heat-treating chamber 14 defined by the base member 15, the retort 16, or equivalent internal wall structure of the furnace, and the removable cover member 17 which serves as a removable closure for the top of the heat-treating chamber 14.

The cover 17 is provided with a downwardly directed flange which is received by the channel 18 at the upper end of retort 16 and filled with sand or other sealing material to prevent escape from chamber 14 of the furnace atmosphere.

The furnace may be gas-fired or electrically heated as shown by aforesaid patents; in the particular furnace shown in Fig. 1, the furnace atmosphere and work are raised to treating temperature by the electrical heater elements 19 suitably supported by the wall structure 20 of the furnace which like base member 15 is of heat-insulating brick and refractory. To minimize heat losses, the cover of the furnace is similarly provided with an outer layer 21 of heat-insulting brick or equivalent.

In the preferred arrangement shown in Fig. 1, the furnace retort 16 has a closed bottom and is supported by the ring or flange provided by the extension of the bottom plate 22 of the fur-

nace beyond the side wall structure 20. In this respect the construction differs from that of aforesaid patents in which the retort has an open bottom with the lower edge received by a sand seal.

For forcible circulation of the furnace atmosphere within the treating chamber 14 so defined, there is provided a fan 23 supported below the open bottom of the work container 11 by attachment to the upper end of a motor shaft 24 which extends through the base 15. Escape of furnace gas along shaft 24 is precluded by a suitable sealing gland. The shaft 24 is driven by motor 25 suitably suspended as by bolts 26 from the underface of the furnace base member 15 which in the embodiment of Fig. 1 is within the retort so that the base 15, motor 25, fan 23 and the combined fan-housing and container support 13 are insertable into and removable from the furnace as a unit with the retort.

As shown more clearly in Figs. 2–5, the housing 13 for the fan 23 comprises a plate 27 which forms the upper wall of the fan housing. This plate is provided with a central opening 28 of diameter suitably less than the diameter of the fan 23 or otherwise suitably apertured to provide a fan inlet. From the underface of plate 27 there downwardly extends a plurality of vanes 29 whose lower edges are free to engage and rest upon the upper face of the base member 15 of the furnace, as shown in Fig. 1. The inner edges 31 of the vanes 29 define a circle of diameter slightly greater than the fan circle, and the outer edges 32 of the vanes define a circle approximately circumscribed by the retort 16. Thus, when the housing 13 is in place, the vanes 29 in coaction with plate 27 of the housing and base 15 of the furnace form fan outlets discharging into the gas-heating space between the retort 16 and the work container 11. Preferably and as shown, the fan 23 is of the centrifugal type and the vanes 29 extending substantially tangent to the fan circle are of spiral or volute form.

As shown most clearly in Figs. 2–5, the vanes 29 project beyond the main circular area of the plate 27 but are respectively joined to that area by minor areas 33 of approximately triangular shape. These minor areas 33 serve as upper walls of the fan outlet ducts and also as barriers which prevent dislodged work objects from entering the fan housing. Objects which fall in the gaps between these areas fall on the flat upper surface of the base 15 below the fan and externally of the housing and so do not damage the fan.

Preferably and as shown, from the main annular area of the plate 27 there upwardly extends a sealing skirt 34 of outline substantially corresponding with that of the work container and having a flange 35, preferably inwardly directed, peripherally to engage the lower edge of the work container for support of the container and its load. Thus, the opening 39 provided by the flange 35 closely approximates the area of the opening in the bottom of the work container for free flow of the furnace atmosphere.

The sealing skirt 34 is stiffened to resist deformation by the weight of the work basket and its contents at the high temperatures involved in heat-treatment by a series of bracing ribs 36 which extend inwardly from the inner periphery of the sealing skirt 34. The inner ends 37 of the sealing ribs serve as stops or centering lugs for positioning a protective screen 38 above the fan inlet opening 28 in the upper wall plate 27 of the fan housing. The opening 39 defined by the flange 35 of the sealing skirt is of larger diameter than the screen 38 to permit easy removal of the screen.

For centering of the work basket 10 as it is lowered into the furnace retort for engagement with the fan housing 13, the housing is provided with a plurality of basket-centering members 40 having upper portions which extend upwardly and outwardly from the upper portion of the housing 13. Specifically, the lower portion of each of the centering members 40 merges with a projecting area 33 of the plate 27, and the inner vertical edge of the lower portion of each of the centering members merges with the periphery of the sealing skirt 34: the centering members therefore also serve to strengthen and stiffen the fan housing structure. As most clearly appears in Fig. 3, the centering members 40 and the ribs 36 are angularly spaced about the periphery of the sealing skirt to afford distribution of the stiffening effects.

The fan housing and basket support 13 is preferably cast as a unitary structure although it may be fabricated from components welded together to form a unitary structure. For long life, the housing 13 should be of metal resistant to the furnace gases and temperatures.

The fan housing and work basket support 13 not only is of advantage in construction and maintenance of the furnace, but also is of operational advantage in that temperature uniformity of a fresh work charge within the container 11 is more rapidly attained. Referring to Fig. 6A, the curve A represents the temperature of work at zone #6 of the work basket, the coolest zone during initial heating, and curve B represents the temperature of work in zone #1, the hottest zone during the initial heating. As apparent from Fig. 6A, which is based upon measurements in a furnace not using the present invention, a substantial difference of temperature exists between these two zones for the initial heating interval T preceding arrival of these zones at the control point or desired heat-treating temperature which in the particular case illustrated is 1550°. With the same furnace construction using, however, the improved fan housing, the temperature difference between the hottest and coolest zones of the furnace during the initial heating significantly is less as shown by the narrowed gap between curves A' and B' of Fig. 6B. For example, with fan housing 13, the work in furnace zone #6 attained a temperature of about 500° when the temperature in zone #1 was about 250° higher (Fig. 6B), whereas with the prior arrangement, by the time the work in zone #6 had attained a temperature of 500° the work in zone #1 was 350° higher (Fig. 6A). Moreover, with the prior arrangement, when the hot zone temperature reached the control point, the temperature spread in the work basket was about 120° (Fig. 6A), whereas with the new arrangement the temperature difference upon arrival at the control point is only about 40°. This feature of the new fan housing is particularly of advantage for short runs, as in tempering, because affording increased furnace output without sacrifice of uniformity of product.

For some heat-treating operations, the furnace atmosphere forcibly circulated by the fan is essentially air; for other heat-treating processes, the furnace atmosphere may comprise or consist of a gas, or gases, inert or active. For use

of treating atmospheres other than air, there is provided, as more fully shown in certain of the aforesaid patents above identified, an inlet **42** (Fig. 1) for admission of the treating gas or source thereof. A sight gauge **43** may be provided when liquid is fed in drops into the furnace for vaporization and liberation of active gaseous agents. An exhaust pipe **44** is provided for escape of the partially depleted furnace atmosphere, a hinged cap **45** being provided to permit insertion and removal of test samples, if desired, during a heat-treating cycle.

Use of the fan housing and work support **13** is not restricted to the top-loading cylindrical type shown in Fig. 1 and may be to advantage used in box furnaces which are side or front-loaded. In Fig. 7, illustrative of one type of box furnace, the fan housing **13** is disposed within the furnace with the lower edges of its vanes **29** resting upon the upper face of the furnace base **15A**. The base, as in Fig. 1, thus forms the lower wall of the fan housing and coacts with the vanes of the housing to define fan discharge ducts which open into the heating space of the furnace between the furnace side walls and the work container resting upon the flanged upper edge of the sealing skirt **34**. In both Figs. 1 and 7 the fan housing is held against the furnace base by bolts or equivalent securing means which engage hold-down lugs **41** extending from at least some of the vanes. In Fig. 7, the upper edge of the sealing skirt **34** is approximately in the same plane as the lower edge of the opening **46** in the front wall of the furnace. Thus, a work basket or container may be slid through the opening onto the fan housing. If desired, rails or guides may be provided to facilitate this loading operation. When used in a box furnace, some of the members **40** may be omitted to avoid obstruction to the work basket as it is slid onto the sealing skirt though at least one of the members **40** may be retained to serve as a rear stop **40A** for the work basket.

It will be understood by those skilled in the art that the invention is not limited to the specific embodiment shown and that changes and modifications may be made within the scope of the appended claims.

What is claimed is:

1. For use in a heat-treating furnace having adjacent its base a fan for forcibly circulating the furnace atmosphere repeatedly through a removable work-container having an open bottom of area substantially coextensive with the cross-

sectional area of the container, a unitary structure forming a fan housing and a work-container support comprising a sealing skirt member having an upper edge for peripherally engaging the bottom edge of the work-container and defining an opening substantially coextensive with said open-bottom area of the work-container, a plate member joined to the lower edge of said skirt member to form the upper wall of the fan housing and apertured within the fan diameter, and a plurality of vanes attached to and extending downwardly from said plate member for engagement with the furnace base which thereupon forms the lower wall of the fan housing and supports said unitary structure, said vanes extending tangentially of the fan diameter to project beyond the periphery of said sealing skirt and the work-container, said plate member having substantially triangular extensions respectively closing the gaps between the upper projecting edges of the vanes and the sealing skirt member.

2. An arrangement as in claim 1 in which the outer vertical edges of the vanes of said unitary structure define a circle closely circumscribed by the periphery of the inner wall structure of the furnace for free discharge from said outer vertical edges of the fan into the heating space between said wall structure and the work-container.

3. An arrangement as in claim 1 in which spaced bracing ribs extend inwardly of the sealing skirt and upwardly of the plate member, the inner ends of said ribs terminating short of the aperture through said plate member, and in which a screen passed by the opening in the sealing skirt member is positioned by said ends of the bracing ribs to overlie the aperture through the plate member.

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