June 19, 1962 J. F. R. JONES 3,039,754

WORK-SUPPORTING BASES FOR COIL ANNEALING FURNACES

Filed July 24, 1959 2 Sheets-Sheet 1

FIG.1.

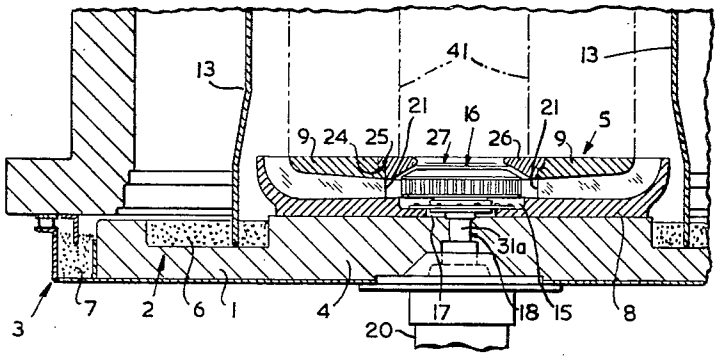
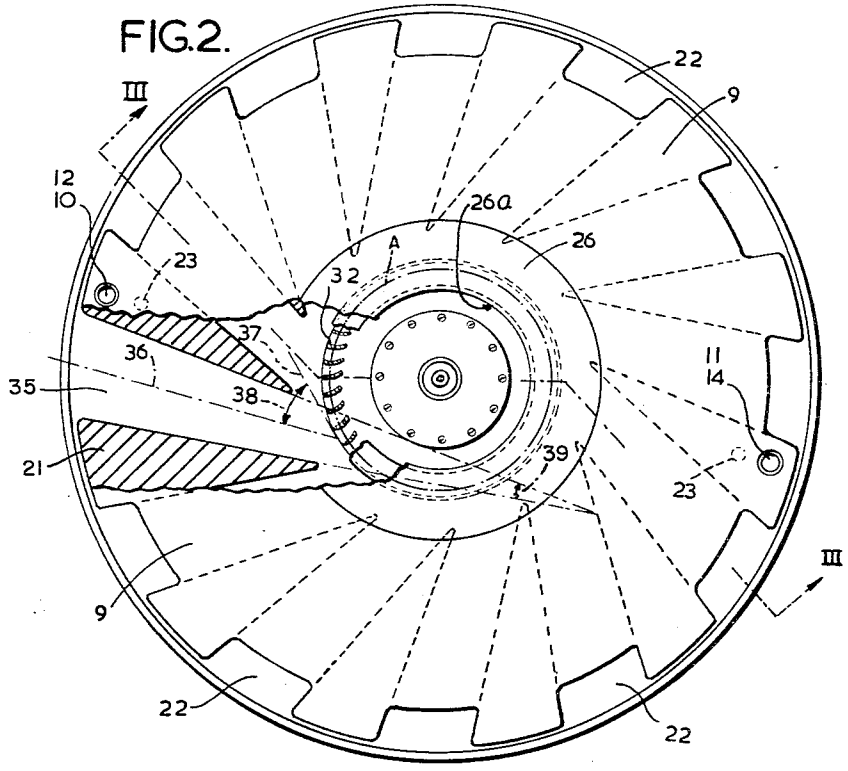


FIG.2.



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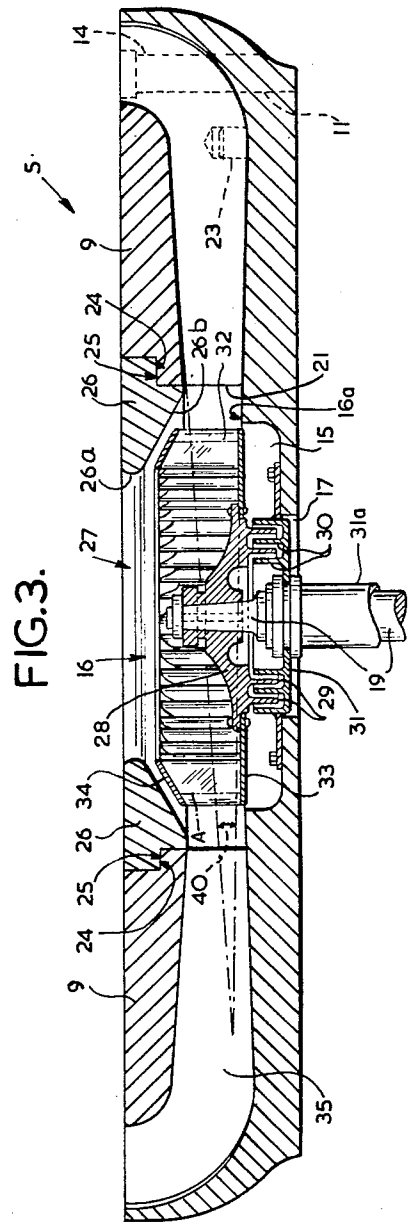


FIG.3.

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WORK-SUPPORTING BASES FOR COIL ANNEALING FURNACES

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To anneal coils of metal wire, strip or sheet, it is common practice to provide the bed or hearth of a furnace with any desired number of upstanding bases and to spread sand over the hearth so that, after stacking a number of coils in concentric relationship upon each of any one or more of the bases, each stack may be enclosed by lowering a separate muffle mouth downwards over the stack until the rim of the muffle mouth seats upon the hearth around the base and is embedded in the sand; after each stack has been so enclosed, a hood provided with any suitable means for heating the muffles, is lowered mouth downwards on to the hearth so as to enclose all the bases and muffles whereupon the gaseous atmosphere (usually a protective gas) within each muffle is circulated at considerable velocity by a fan or impeller accommodated within the corresponding base, to expedite the transfer of heat between the muffle walls and the stack of coils. If desired, the circulation of the atmosphere may be continued after the coils have been heated uniformly to a predetermined temperature and the hood has been removed from the hearth.

This invention has reference to the work-supporting bases of annealing furnaces of the above-mentioned kind.

The principal object of the present invention is to provide an improved construction of work-supporting base which is adapted to operate at maximum efficiency in that, for any given power input to the fan or impeller in any one of the bases, a maximum mass flow rate of the circulated atmosphere is obtained within the corresponding muffle and, consequently, the rate of heat transfer between the muffle walls and the stacked coils is increased and the duration of each annealing cycle is reduced.

In view of the considerable velocity at which the muffle atmosphere is circulated, there has existed heretofore, the danger that some of the sand on the furnace hearth may be blown on to the stacked coils causing blemishing of the metal and/or damage to tools during subsequent processing operations. A further object of the invention is to minimise the possibility of the said sand being disturbed by the circulation of the atmosphere within the muffle or muffles.

The above and other objects of the invention will be clear from the following specification when read in conjunction with the accompanying drawings which show a typical embodiment of the invention.

In the said drawings:

FIGURE 1 is a diagrammatic sectional elevation of a part of the hearth of a coil annealing furnace.

FIGURE 2 is a plan, partly in section and on an enlarged scale, of the coil-supporting base shown in FIGURE 1, and

FIGURE 3 is a section, on a still bigger scale, along the line III—III, FIGURE 2.

The furnace bed or hearth **1** of which a part is shown in FIGURE 1 has an annular well **2** in its upper surface, is surrounded by a trough **3**, and is provided with at least one pedestal **4** which projects above the mouth of the well and carries a coil-supporting base **5** on its upper surface. A layer **6** of sand is spread over the floor of the well and an additional layer **7** of sand is contained within the trough.

The coil-supporting base consists of two superimposed circular plates, namely a saucer-shaped bottom plate **8** which seats upon the upper surface of the pedestal, and a top plate **9** which fits within and fills the bottom plate.

The upper surface of the marginal or peripheral zone of the bottom plate is swept upwardly along a curve of predetermined radius of which the centre lies in the plane of the rim or mouth of the plate, whereas the underside of the said plate is flat and seats upon and, if desired, may be bolted or otherwise detachably secured to the top and concentrically of the pedestal **4** so that the whole of the base is located above the level of the sand layer **6**.

In the vicinity of its upwardly swept peripheral zone, ports **10** and **11** extend through the bottom plate so that, when the furnace is in operation, a protective atmosphere gas may be fed from an inlet pipe (not shown) in the pedestal, into and through one of the said ports, for example port **10**, and a complementary registering port **12** in the top plate, for circulation within the interior of a cylindrical muffle **13** of which the mouth encircles the pedestal and is embedded in the sand layer **6**, the other of the said ports, and a complementary registering port **14** in the top plate, enabling excess gas to be exhausted from the muffle through the base and a discharge pipe (not shown) in the pedestal.

A circular and concentric depression **15** in the centre of the upper surface of the bottom plate is of a diameter in excess of the diameter of the external periphery of an impeller **16** accommodated within a chamber **16*a*** formed in and concentrically of the base, and a concentric hole **17** in the centre of the floor of the said depression is coaxial with a bore **18** in the pedestal to enable the impeller driving shaft **19** to extend into the interior of the bottom plate from a housing **20** assembled to and depending below the underside of the furnace hearth.

The top plate consists of an annulus which makes a free fit within the bottom plate and, on its underside, is provided with a number of depending duct-defining ribs **21** which are of triangular shape in plan, extend from the internal periphery to the external periphery of the annulus, and are of a depth and shape such that their lower edges seat upon the upper surface and upswept peripheral zone of the bottom plate, and the upper surface of the top plate is flush with the rim of the said bottom plate with the result that the spaces between adjacent ribs provide ducts in and around the coil-supporting base. A separate recess **22** is formed in the external periphery of the top plate between the outer and wider ends of each two adjacent ribs, each recess opening to the upper and lower surfaces of the plate and spanning the clearance between the said rib ends so that, in combination with the upswept peripheral zone of the bottom plate, it forms an upswept end portion of the corresponding duct; the external edges of the said wider rib ends are shaped to conform to and make contact with the surface of the upswept peripheral zone of the bottom plate.

Each of the gas ports **12**, **14** in the top plate is located between two of the peripheral recesses **22** and, if desired, holes (not shown) may extend downwardly through any desired number of the ribs to enable the top plate to be bolted or otherwise detachably and rigidly secured to and internally of the bottom plate. Studs **23** projecting upwardly of the floor of the bottom plate engage in complementary pockets in the underside of the top plate to ensure that the top plate is positioned in a predetermined relationship within the bottom plate.

The internal periphery of the top plate is of greater diameter than the central recess **15** in the bottom plate and, between the top and underside of the top plate, is formed with an annular shoulder **24** which provides a seat for a complementary shoulder formed around the external periphery of a throat ring **26** nested within the top plate and serving as the gas inlet eye **27** of the base. The internal periphery of the throat ring is of substantially

semi-circular convex section around its end portion **26***a* which opens to the upper surface of the base and below the said portion the periphery is formed with an outwardly and downwardly flared portion **26***b* which reaches towards the underside of the top plate. Alternatively, and if desired, the throat ring may be an integral part of the top plate.

The impeller **16** (see FIGURE 3) comprises a centrally bored hub **28** which is keyed or otherwise made fast upon the driving shaft **19**, and is formed on its underside with a depending, circumferentially channelled, concentric skirt **29**, the sides of the channel depending into corresponding clearances between upstanding annular baffle rings **30** provided on a disc **31** which spans and closes the aperture **17** and is bolted to the floor of the central recess **15** in the bottom plate. A sleeve **31***a* enclosing the shaft **19** extends into and is clamped to the said closure disc.

A system of transversely curved impeller blades **32** is secured between and perpendicularly to an annular carrier plate **33** assembled to and projecting radially beyond the impeller hub, and a frusto-conical annular head plate **34** disposed adjacent and substantially parallel to the flared portion **26***b* of the throat ring, the external diameters of the said carrier and head plates being equal but less than the diameter of the central recess in the bottom plate of the base, and the internal diameter of the head plate being greater than the minimum or effective diameter of the throat ring.

Each impeller blade is so arranged that its concave cylindrical surface leads when the impeller is rotating, and the centre of curvature of the said face lies in an imaginary circle which is concentric to the internal and external peripheries of the head plate, and is located between the said peripheries but nearer to the external than the internal peripheries.

When, for example, and as shown in FIGURE 2, the work-supporting base is formed with twelve ducts **35** each extending from the internal periphery of the top plate and terminating at the rim of the upswept peripheral zone of the bottom plate, and the external diameter of the impeller head and carrier plates is 23 inches, the said impeller may be provided with forty-eight curved blades **32** which are spaced equidistantly apart around and between the said plates **33** and **34**, and extend from the internal to the external peripheries of the head plate; in such circumstances the leading concave face of each blade may have a radius of two inches and the axis of curvature of the said face may lie in an imaginary circle A concentric to and located between the said peripheries and removed from internal periphery by a distance of, or in the vicinity of, four times the distance by which it is removed from the external periphery.

Moreover, each of the twelve ducts is disposed within the base so that its longitudinal centre line **36** is inclined forwardly in the direction of impeller rotation and, when the said line is extended beyond the duct into the said impeller, the extension intersects the tangent **37** to a circle passing through the outer edges of the forty-eight curved blades a an angle **38** of, or in the region of 45°, the exact dimension of the said angle varying with such factors as the overall diameter and the intended speed of rotation of the impeller, the number, inclination and dimensions of the blades, or the number and minimum cross-sectional area of the ducts.

The formation of the depending triangular ribs **21** on the underside of the top plate, is such that inwardly of their upswept outer ends the ducts have straight, flat or plane side walls which diverge relatively to one another away from the impeller at an included angle **39** of from 6° to 8°; hence the width of each duct increases gradually towards the upswept end portion thereof. Further, the ribbed underside of the top plate and upper surface of the bottom plate inwardly of the upswept peripheral curved zones of the said plates are also straight, flat or plane and

relatively inclined at an included angle **40** of from 6° to 8°, so that the ducts have straight, flat or plane top and bottom walls which also diverge away from the impeller and increase the depth of each duct gradually and uniformly; since both the width and depth of each duct increases, it follows that the cross sectional area also increases, the area increase being at the rate of 60–80% per foot length of duct and taking place between the duct end adjacent the impeller and the commencement of the opposite upswept end portion which, if desired, may have a uniform cross sectional area.

The upswept end portions of the ducts ensure that the atmosphere gas blown through and from the ducts as a consequence of rotation of the impeller, is projected vertically upwards from the crown of the base with a minimum possibility of disturbing the sand layer **6** in which the rim of the base-enclosing muffle **13** is embedded.

The provision of the plane-walled ducts which gradually increase in cross-sectional area as far as their upswept outlet end portions, and an impeller of appropriate design, ensures maximum mass flow rate of gas circulation for any given power input to the impeller motor, thereby increasing the rate of heat transfer between the muffles and the coils **41** supported on the base, and minimising the duration of the annealing cycle of the said coils, whereas the angular relationship of the ducts to the impeller minimises turbulence and consequent loss of energy in the circulating gas stream.

It is to be understood that the embodiment of the invention described and shown in the drawings is only a typical example of how the invention should be carried into effect and that various modifications may be made within the scope of the following claims.

I claim:

1. A work-supporting base for an annealing furnace of the kind referred to, having a upper work-supporting surface, a gas intake eye in the centre and an annular system of gas outlet ports at the periphery of the said surface, an internal impeller chamber which is concentric to and into which the said eye opens, and a system of plane-walled ducts each of which extends through the base from the periphery of the said chamber towards the periphery of the base, is rectangular in cross section and increases in cross-sectional area from the said chamber periphery to an upswept and curved end portion of which the centre of curvature lies in the work-supporting surface and which opens to the said surface through a corresponding one of the said ports.

2. A work-supporting base for an annealing furnace of the kind referred to, having an upper work-supporting surface, a gas intake eye at the centre and an annular system of gas outlet ports at the periphery of the said surface, an internal impeller chamber which is concentric to and into which the said eye opens, and a system of ducts each of which extends through the base from the periphery of the said chamber towards the periphery of the base, has plane walls and is of rectangular cross section, each two opposed walls of each duct being relatively inclined so that the cross sectional area of the duct increases gradually and uniformly from the chamber periphery to an end portion of the duct which is swept and curved upwardly and opens to the said surface through a corresponding one of the said ports.

3. A work-supporting base for an annealing furnace of the kind referred to, having an upper work-supporting surface, a gas intake eye at the centre and an annular system of gas outlet ports at the periphery of the said surface, an internal impeller chamber which is concentric to and into which the said eye opens, and a system of ducts each of which extends through the base from the periphery of the said chamber towards the periphery of the base, has plane straight walls and is of rectangular cross section, each two opposed walls of each duct being relatively inclined at an included angle of from 6° to 8° so that the cross sectional area of the duct increases

gradually and uniformly at a rate ranging from 60% to 80% per unit length from the chamber periphery to an end portion of the duct which is swept and curved upwardly and opens to the said surface through a corresponding one of the said ports.

4. A work-supporting base for an annealing furnace of the kind referred to, having an upper work-supporting surface, a gas intake eye in the centre and an annular system of gas outlet ports at the periphery of the said surface, an internal impeller chamber which is concentric to and into which the said eye opens, and a system of plane-walled ducts each of which extends through the base from the periphery of the said chamber towards the periphery of the base and is so located within the base that its longitudinal centre line intersects the said chamber periphery at an angle in the region of 45° to the tangent passing through the point of intersection, each of the said upswept end portions opening to the said work-supporting surface through a corresponding one of the said ports.

5. A work-supporting base for an annealing furnace of the kind referred to, having an upper work-supporting surface, a gas intake eye in the centre and an annular system of gas outlet ports at the periphery of the said surface, an internal impeller chamber which is concentric to and into which the said eye opens, and a system of ducts each of which extends through the base from the periphery of the said chamber to an upswept and curved end portion which reaches to the periphery of the base, has plane walls, is of rectangular cross section and is so located within the base that its longitudinal centre line intersects the chamber periphery at an angle in the region of 45° to the tangent passing through the point of intersection, each of the said end portions opening to the work-supporting surface through a corresponding one of the said ports and its centre of curvature being located in the said surface, and each two opposed walls of the duct being inclined at an included angle of from 6° to 8° so that the cross sectional area of the duct increases gradually and uniformly from the chamber periphery at least to the said upswept end portion at a rate ranging between 60% and 80% per unit length.

6. A work-supporting base for an annealing furnace of the kind referred to, having an upper work-supporting surface, a gas intake eye in the centre and an annular system of gas outlet ports at the periphery of the said surface, an internal chamber which is concentric to and into which the said eye opens, and a system of plane-walled ducts each of which extends through the base from the periphery of the said chamber, is rectangular in cross section and increases gradually and uniformly in cross sectional area away from the said chamber at least as far as an upswept and curved end portion which opens to the work-supporting surface through a corresponding one of the said ports and of which the centre of curvature is located in the said surface, and an impeller housed within and concentrically of the said chamber, the said impeller comprising a carrier plate which is fastened upon a driving shaft journalled in the base, an annular head plate and a system of blades fixed to and between the carrier and head plates, each of the said blades being portions of cylinders and curved transversely with the axis of curvature of its concave face being located in an imaginary cylinder which is concentric to and lies between the internal and external peripheries of the head plate and is spaced from said internal periphery by a distance which is approximately four times greater than the distance between the cylinder and the said external periphery.

7. A work-supporting base for an annealing furnace of the kind referred to, comprising two superimposed separable circular plates, the bottom plate having an upper surface shaped to define a shallow depression terminating in a raised peripheral rim and said upper surface being formed with an upswept and concave curved peripheral zone of which the centre of curvature lies in the plane of the rim of the said bottom plate, and the upper plate being of annular form, being accommodated within the bottom plate with its upper work supporting surface located in the said plane, having an external diameter equal to the internal rim diameter of the bottom plate, being formed on its underside with integral, duct-defining and triangular ribs which extend between the internal and external peripheries of the said top plate and seat upon the upper surface of the bottom plate, being formed in its external periphery and between each two adjacent ribs with a recess which is open to the said work-supporting surface and of which the edge remote from the periphery of the upper plate is curved and concentric to the said upswept peripheral zone, and each of the said ducts having plane opposed walls between the internal periphery of the said top plate and the upswept peripheral zone of the said bottom plate, increasing gradually and uniformly in cross sectional area away from the said internal periphery at a rate between 60% and 80% per unit length, and being so located that its longitudinal centre line intersects the said internal periphery at an angle in the region of 45° to a tangent passing through the point of intersection.

References Cited in the file of this patent

UNITED STATES PATENTS

2,309,700	Huff	Feb. 2, 1943
2,671,656	Winder	Mar. 9, 1954
2,731,254	Campbell	Jan. 17, 1956
2,789,808	Blackman	Apr. 23, 1957
2,998,236	Cramer et al.	Aug. 29, 1961

FOREIGN PATENTS

218,602	Great Britain	July 7, 1924
755,034	Great Britain	Aug. 15, 1956