June 9, 1959 F. KRALL ET AL 2,890,258

CONCENTRIC POWER CONNECTION FOR INDUCTION FURNACES

Filed March 8, 1957 2 Sheets-Sheet 1

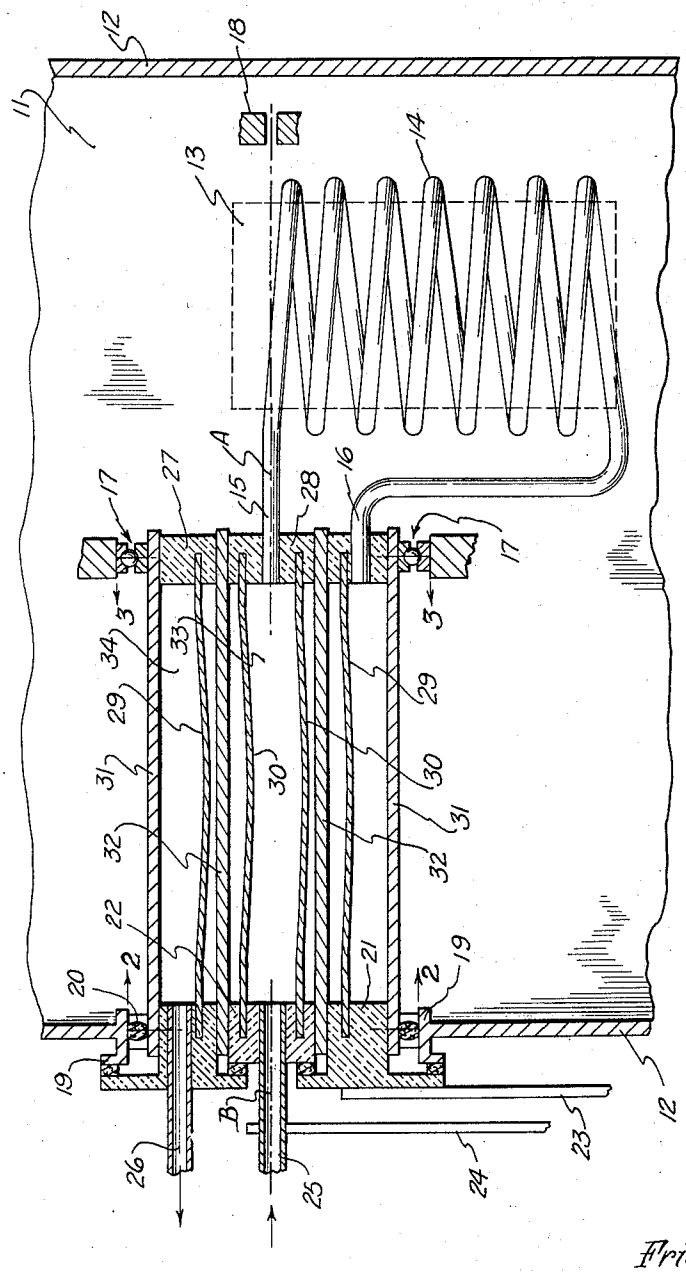


Fig. 1

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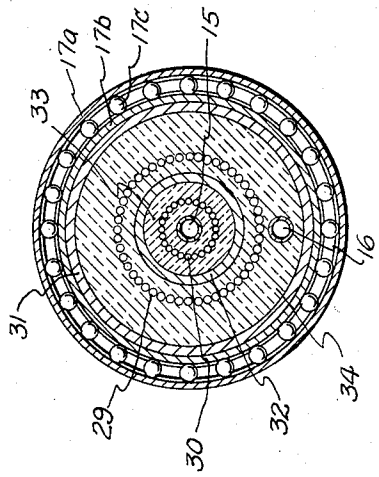


Fig. 3

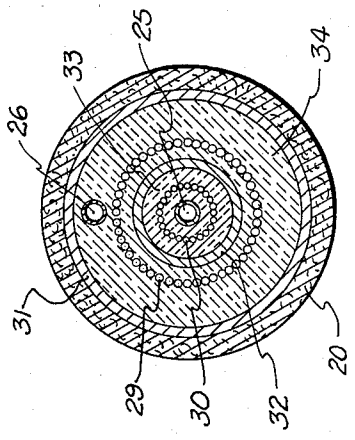


Fig. 2

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CONCENTRIC POWER CONNECTION FOR INDUCTION FURNACES

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Claims priority, application Germany March 9, 1956

3 Claims. (Cl. 13—31)

This invention relates to the power supply for induction furnaces. In particular, the invention is directed to a flexible lead-in connection for the electric and cooling water supply for the furnace induction coil.

In high vacuum induction furnaces, the induction windings surrounding the melting pot are turnably mounted so as to permit the tilting of the pot. With water cooled coils, the problem is to form a suitable turnable connection for the electric and water supply lines. Heretofore, this has been accomplished by means of two concentric copper tubes which pass through the wall of the vacuum chamber; and on the outside, the electric lines are connected to the power supply by means of movable clamps or flexible cables.

However, these concentric constructional forms are characterized by their stiff and rigid construction. This causes the disadvantages principally in that the axis of the tilting axle of the pot must be exactly coaxial with the lead-in plug in the wall of the vacuum chamber. This requirement is not easily met, because the weight of the melting pot, together with the thermal strains in the pot and vacuum chamber supports, can cause distortions of the tilting axle of the pot to appear under operating conditions, which causes jamming in the lead-in plug and faulty operation. Moreover, an exact alignment of the various heavy parts, such as the melting pot and the vacuum chamber, is very difficult.

The object of the instant invention is to construct a flexible lead-in connection for the electric and water lines attached to the induction coil of the melting pot in a vacuum chamber, so that the melting pot can be tilted and moved without disrupting the connection.

In general, the object is obtained by using two connecting joints, one mounted in the vacuum chamber wall and the other mounted in the chamber adjacent the induction coil. The inner joint adjacent the coil is a connection bearing composed of two concentric copper rings joined to the coil and turnable in a bearing mounting. In the wall of the vacuum chamber is a lead-in plug which supports the plug connection also composed of two concentric copper rings. These latter rings are connected to the power supply bus bars and are sealed to the wall of the chamber. Two concentric flexible insulating tubes, formed, for example, of polyvinylchloride, extend between the plug rings and the bearing rings. The tubes are tightly joined to the bearing rings; and, within the vacuum chamber, the opposite ends of the tubes are loosely fitted over the copper rings, but the outer tube is tightly fastened to the wall of the chamber. Flexible high frequency electric wires extend between the plug rings and bearing rings, respectively, with the ends of the wires permanently joined to the rings. In the upright vertical position of the melting pot, these wires are slack.

Provision is also made for passing cooling water through the rings. This cooling water not only flows through the tubular induction coil, but also through the flexible insulating tubes to cool the electric wires extending therethrough.

The means by which the object of the invention is obtained is described more fully with reference to the accompanying drawings, in which:

Figure 1 is a longitudinal cross-sectional view through the flexible connection mounted in the wall of the vacuum chamber and attached to the induction coil for the melting pot;

Figure 2 is a cross-sectional view on the line 2—2 of Figure 1; and

Figure 3 is a cross-sectional view on the line 3—3 of Figure 1.

The vacuum chamber **11** having wall **12** contains a melting pot **13**, indicated by dashed lines, the pot being surrounded by the tubular induction coil **14** with the two ends **15** and **16**. Pot **13** is turnable on an axle, indicated by its axis A. For reasons of clarity, the axle itself is not shown. This axle is supported by bearings **17** and **18**. The axis B of the lead-in plug **19** is coaxial with axis A and extends through wall **12**. Plug **19** is sealed in the wall by conventional packing held by the pressure rings **20**. Plug **19** is composed of two concentric permanently mounted copper rings **21** and **22**. These copper rings outwardly of wall **12** are joined to the power supply bus bars **23** and **24**. Rings **21** and **22** also have openings for the water supply. Inlet water supply pipe **25** extends through ring **22**, and the return water pipe **26** extends through ring **21**.

The bearing connection is composed of concentric copper rings **27** and **28** mounted in bearing **17**. Coil end **15** passes through ring **28**, while end **16** passes through ring **27**. Electric power for the coil must be led from ring **21** to ring **27** and from ring **22** to ring **28**. This is accomplished by means of two circularly arranged groups of high frequency wires **29** and **30**. These two groups of wires are respectively surrounded by polyvinylchloride insulating tubes. The outer wire **29** is surrounded by tube **31**, while the inner wire **30** is surrounded by tube **32**. In the connection bearing, tubes **31** and **32** are tightly fastened to rings **27** and **28**, with the tube **31** surrounding the outer periphery of ring **27** and the tube **32** surrounding ring **28** and forming an insulating seal between rings **27** and **28**. Tube **32** also provides insulation between wires **29** and **30**. In the plug **19**, mounted in wall **12**, tubes **31** and **32** are loosely fitted over rings **21** and **22**. The inner tube **32** provides the insulation between rings **21** and **22**. The outer ring is tightly fitted against the packing held by the pressure rings **20**.

The cooling water flows through pipe **25** into the space **33**, within tube **32**, and then through coil end **15** into the coil and out through coil end **16** into space **34** within tube **31**, and then drains through pipe **26**. Consequently, wires **29** and **30** mounted in spaces **33** and **34** are washed and cooled by the water.

Wires **29** and **30**, as well as tubes **31** and **32**, are flexible and elastic. Therefore, any misalignment of the axes A and B will not cause a jamming thereof. Optimumably, axes A and B are in coaxial alignment.

The copper rings **27** and **28**, together with the tubes **31** and **32**, constitute a unique body which is turnable within bearing **17** and which is joined to ends **15** and **16** of coil **14**. This connection bearing is turned when the pot, together with its coil, is tilted. Tubes **31** and **32** are slidable in plug **19** so that they can move around independently of the fixed rings **21** and **22**. The ends of wires **29** and **30** are fixed to the respective copper rings with the ends of the wires fastened to rings **27** and **28**, being movable therewith. This permits a turning of the wires through an angle as great as 120°.

Fig. 2 reflects cross-sectional view **2—2** and Fig. 3

cross-sectional view 3—3 in Fig. 1. In both cases **29** and **30** represent the two groups of high frequency wires, and **31** and **32** the polyvinyl chloride insulating tubes. As in Fig. 1 the pressure rings are marked **20**, the water supply pipe **25** and the return water pipe **26**. In Fig. 3, **15** and **16** represent the ends of the induction coil and simultaneously the water supply pipe and the return water pipe for the induction coil. Ball bearing **17** shown in Fig. 1 is here divided in the fixed part **17***a*, the movable part **17***b*, and the balls **17***c*.

As wires **29** and **30** as well as tubes **31** and **32** are flexible and elastic, all axis misalignments expected to occur in practice, and also a restricted longitudinal movement of tubes **31** and **32** is possible without entailing leakage of the pressure rings **20**. Tubes **31** and **32** are fitted over rings **21** and **22** so as to, on the one hand, allow rotation within the fixed rings, and on the other hand, avoid that practically no cooling water contained in space **33** flows from space **33** into space **34**.

Having now described the means by which the object of the invention is obtained, we claim:

1. An electric power and water line connection for high vacuum induction furnaces having a melting pot with an induction coil contained within the wall of a vacuum chamber comprising a connection bearing within said chamber between said wall and pot and coaxial with the tilting axis of said pot composed of inner and outer concentric copper bearing rings, means mounting said rings for rotation around said axis, and means electrically connecting said rings, respectively, to said induction coil; a connection plug mounted in the wall of said chamber composed of inner and outer concentric copper plug rings respectively coaxial with said bearing rings electrically joined to bus bars outside of said chamber; an inner and an outer polyvinylchloride flexible insulating tube, an end of the inner tube spacing said inner and outer bearing rings, and an end of said outer tube enclosing said outer bearing ring, with the opposite end of said inner tube loosely fitted between said inner and outer plug rings, and the opposite end of the outer tube loosely covering the outer plug ring but tightly fitted to the outer circumference of said plug; and flexible wire electrical conductors extending between the outer rings, and the inner rings, respectively, said conductors being slack when said melting pot is in vertical position.

2. An electric power and water line connection as in claim 1, further comprising cooling water inlet and outlet pipe lines connected, respectively, with said inner and outer plug rings for providing cooling water to the spaces within said insulating tubes and to said induction coil.

3. An electric power and water line connection for high vacuum induction furnaces having a melting pot with an induction coil contained within the wall of a vacuum chamber comprising a connection bearing within said chamber between said wall and pot composed of inner and outer concentric copper bearing rings, means mounting said rings for rotation about their axis, and means electrically connecting said rings, respectively, to said induction coil; a connection plug mounted in the wall of said chamber composed of inner and outer concentric copper plug rings, respectively, electrically joined to bus bars outside of said chamber; an inner and an outer polyvinylchloride flexible insulating tube, an end of the inner tube spacing said inner and outer bearing rings, and an end of said outer tube enclosing said outer bearing ring, with the opposite end of said inner tube loosely fitted between said inner and outer plug rings, and the opposite end of the outer tube loosely covering the outer plug ring but tightly fitted to the outer circumference of said plug; and flexible wire electrical conductors extending between the outer rings, and the inner rings, respectively, said conductors being slack when said melting pot is in vertical position.

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