July 25, 1944. R. P. KOEHRING 2,354,523

HEAT TREATING APPARATUS

Filed April 22, 1941

Fig. 2.

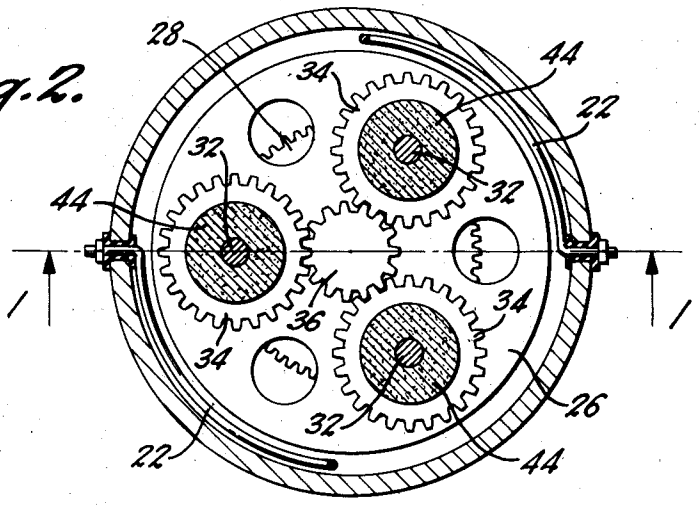
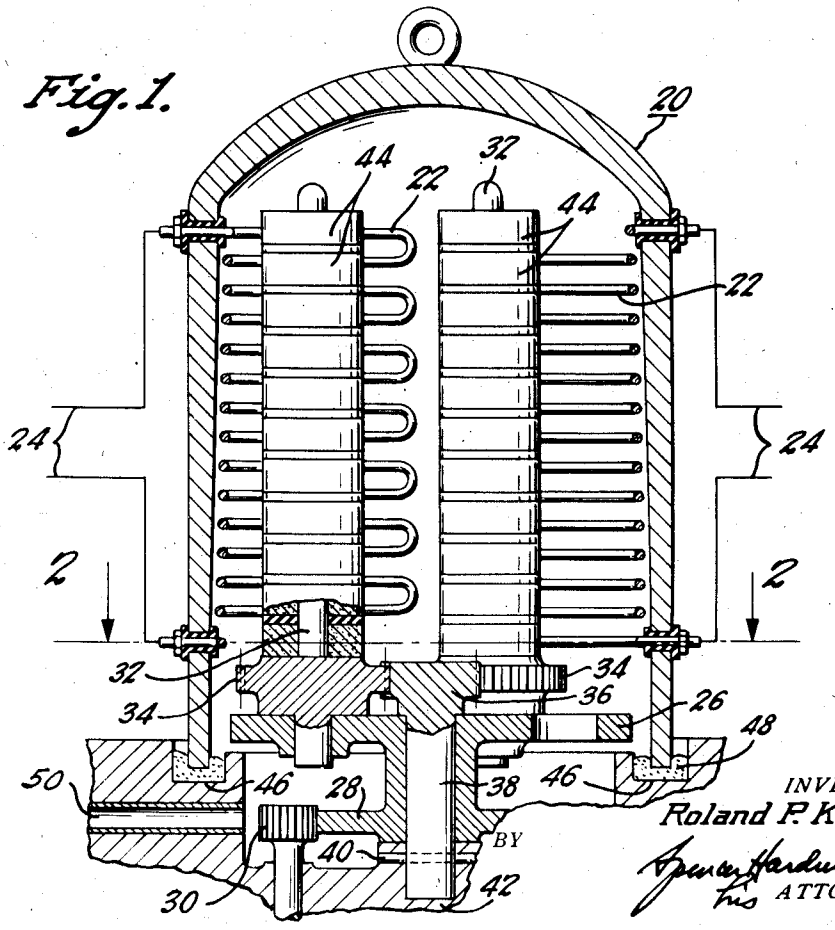


Fig. 1.



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HEAT-TREATING APPARATUS

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2 Claims. (Cl. 13—22)

The present invention relates to heat treating furnaces and is particularly concerned with the heat treating furnaces of the bell type.

An object of the invention is to provide an apparatus for sintering and heat treating metal parts wherein the metal parts are rotated relative to the walls of the furnace for equalizing the temperature of the metal parts.

In carrying out the above object it is a further object to provide a table within the furnace which is rotatable with respect to the furnace which table includes portions thereof relatively rotatable thereto and at different rates of speed whereby articles placed on said portions are rotatable relative to the table and the table is rotatable relative to the furnace.

A further object of the invention is to provide a planetary system for use in heat treating furnaces wherein articles may be placed on one portion of the system, which portion is rotated upon its own axis while simultaneously being rotated in an orbit around the center of the furnace.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a cross sectional view of a bell type furnace including the invention disclosed herein and taken on the line 1—1 of Fig. 2; and

Fig. 2 is a view taken on the line 2—2 of Fig. 1.

When heat treating metal parts in bell type furnaces, it is often impossible to obtain equal heating of the parts being treated due to the fact that certain surfaces thereof are heated by radiated heat while other surfaces must depend upon conducted heat. Similarly the temperature at one side of the furnace may be much higher than the temperature on the other side of the furnace thereby creating a spotty heat distribution which is very undesirable. Uniform heating is particularly desirable during sintering of porous metal parts wherein a short time sintering period is utilized during which period alloying and sometimes bonding of the porous metal to a steel supporting surface must be accomplished. In sintering porous metal parts, for example, annular clutch discs which include a steel backing having a briquetted powder metal layer thereon it is customary to pile these discs or plates upon a pilot within the furnace so that a plurality of plates are in the pile and each of the plates is under the desired pressure which may be applied to the top of the pile. It is obvious that if the heat distribution in a furnace of this type is uniform that a better bond will be accomplished and with greater uniformity and strength.

This invention is particularly concerned with eliminating these past difficulties in obtaining uniform heating of parts such as discs or other metal parts to be sintered or otherwise heat treated within a bell type furnace. To this end it is proposed to utilize a planetary heat equalizing apparatus wherein a plurality of piles of discs may be placed within the furnace and since the discs are moved relative to the heating surfaces to obtain uniform heat distribution, it is immaterial whether or not each disc is equidistant from the heating element which obviously is a limiting factor in apparatus used prior to my invention whereby only one pile of discs could be sintered at one time.

Referring particularly to Fig. 1, a bell type furnace 20 is shown which includes electrical heating elements 22 around the walls and conforming to the shape thereof, these may be connected to suitable power source 24, gas heating may be employed if desired in any well-known manner. At the lower end of the furnace a rotatable table 26 is shown which carries a gear 28 that is driven from a gear 30 attached to a suitable motivating means, not shown. Thus the rotatable table 26 is rotated slowly relative to the furnace heating surfaces. A plurality of vertically extending pilots 32 are provided which are journaled on the table and are rotatable with respect thereto. Each pilot has a gear 34 adjacent the bottom thereof which meshes with a central gear 36 which is stationary, being mounted on a shaft 38 that is pinned by pin 40 to the base section 42 of the furnace. Thus as gear 30 turns the table 26, each of the pilots 32 are rotated relatively to the table by the action of the gears 34 and 36. In this manner, the pilots simulate planets into a planetary system which rotate on an orbit at a given speed determined by the speed of the table 26 and which rotate on their own axis at a different rate of speed. Upon the pilots 32 may be stacked a plurality of plates 44 which in the present are clutch plates although it is obvious that any other flat article may be stacked upon the pilot or if the articles are not annular they may be stacked upon the table carried by gears 34. Pressure may be exerted to the stack of plates by the addition of a weight on top thereof or by spring means, not shown, such expedients being well known. The plates 44 may

be spaced one from the other by a layer of alundum or by thin graphite sheets or by a layer of graphite so that adjacent plates do not stick together during sintering.

When sintering porous metal parts it is also desirable that the atmosphere within the furnace is non-oxidizing in nature, such atmospheres as incompletely burned natural gas, hydrogen atmosphere, cracked ammonium atmosphere, etc. being satisfactory. The furnace is sealed to the air by means of the annular passage **46** in the base **42**. This passage is filled with sand **48** or high boiling point oil and when the bell furnace is lowered therein the lower edge thereof effectively seals the inside of the furnace from the atmosphere. The nonoxidizing gas is admitted to the furnace through a pipe **50** whereby the pressure inside the furnace is maintained in excess of the atmospheric pressure; a slight leakage through the seal preferably results.

When sintering porous metal parts it is desirable to carry out the operation under suitable sintering temperatures which temperatures are generally intermediate the melting points of the component metals to be sintered, for example, if a bronze clutch plate is to be sintered a sintering temperature intermediate the melting point of copper and tin may be used preferably between 1500 to 1700° F. Similarly if copper-nickel powder comprises the briquetted powder metal layer, sintering temperatures between the melting points of copper and nickel is maintained—for example, in the neighborhood of 2000° F.–2050° F. is preferable. When sintering a single metal powder, such as iron powder, it is preferable to carry out the sintering operation at a high temperature but below the melting point of the metal. In the case of iron it has been found that a temperature of about 2050° F. is satisfactory. In each case the metal powder is preferably briquetted prior to sintering and a wide range of pressure may be used for this step, for example, from 10,000 to 70,000 pounds per square inch. If additional pressure is applied to a stack of plates during sintering thereof it is possible in some cases to use loose metal powders which are supported upon a sheet of steel or the like in a layer of defined thickness which upon sintering is compressed due to the pressure applied to the stack. The compression improves the bonding between the powdered metal layer and the steel and likewise reduces the porosity of the porous metal layer.

It is obvious that porous metal layers which are not bonded to steel may be sintered in a like manner.

The foregoing examples have been given for illustrative purposes only.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. Apparatus for heat treating a plurality of stacked annular plates comprising in combination; a removable bell type furnace cover, electrical heating means disposed adjacent the internal vertical surfaces of said cover, a rotatable table member adapted to be enclosed by said cover, a pilot carried by said table member and relatively rotatable with respect thereto, said pilot being adapted to carry a stack of said annular plates to be heat treated; means for rotating the table member and the pilot at different rates of speed whereby different surfaces of said plates are exposed to the heating surfaces of the furnace, and means for introducing a controlled atmosphere into said furnace for preventing oxidation of said plates said means being disposed so as to direct the flow of controlled atmosphere over said means for rotating the table whereby said means is maintained at a temperature less than the heat treating temperature.

2. Apparatus for heat treating a plurality of stacked annular plates comprising in combination; a removable bell type furnace cover, electrical heating means disposed adjacent the internal vertical surfaces of said cover, a rotatable table member adapted to be enclosed by said cover, a plurality of pilots carried by said table member and relatively rotatable with respect thereto, said pilots being adapted to carry stacks of said annular plates to be heat treated; means for rotating the table member and pilots at different rates of speed whereby different surfaces of said plates are exposed to the heating surfaces of the furnace, and means for introducing a controlled atmosphere into said furnace for preventing oxidation of said plates said means being disposed so as to direct the flow of controlled atmosphere over said means for rotating the table whereby said means is maintained at a temperature less than the heat treating temperature.

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