Feb. 7, 1933. H. PETERSSON 1,896,643

PROCESS OF MAKING TUNGSTEN ALLOYS

Filed Aug. 5, 1929

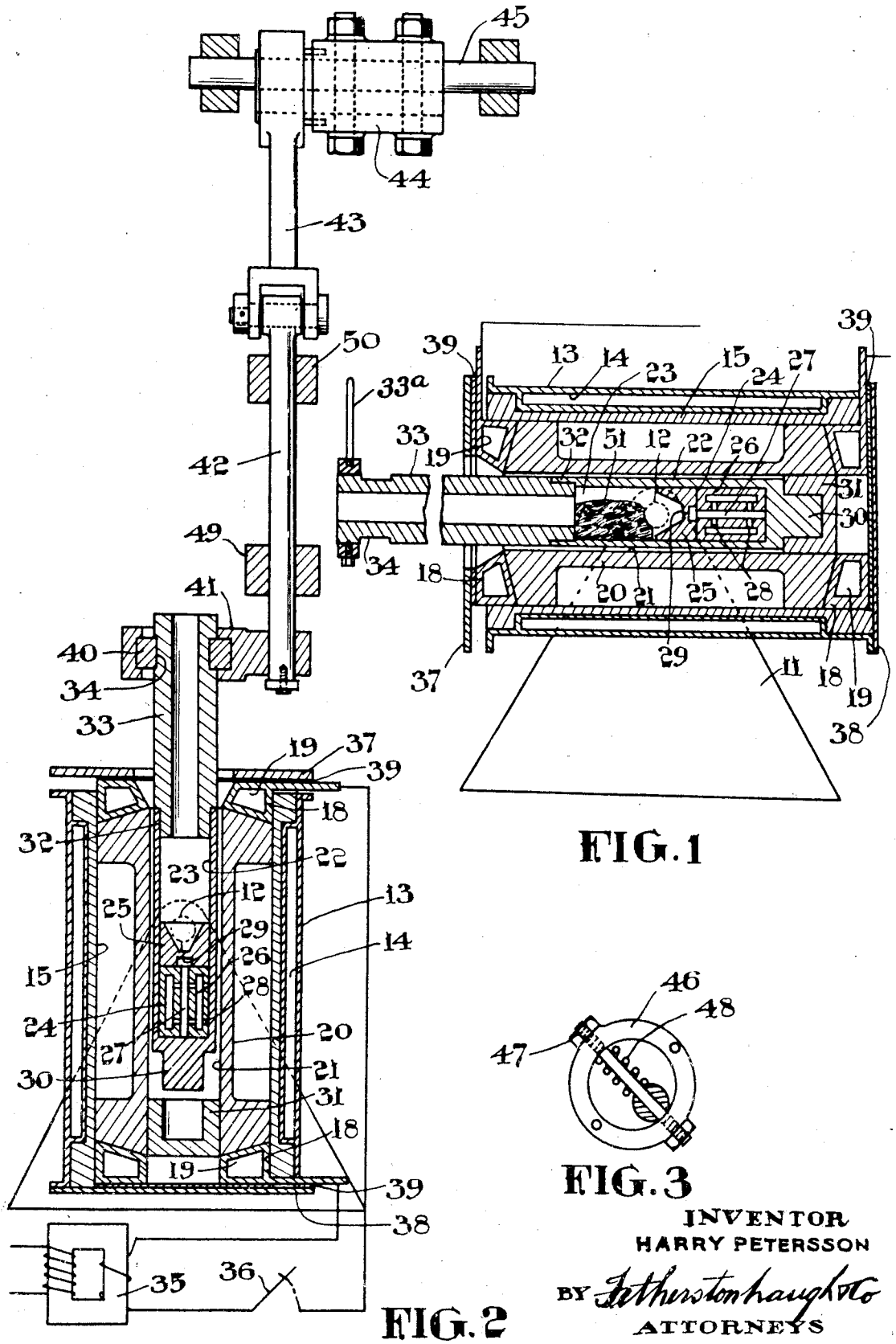


FIG. 1

FIG. 2

FIG. 3

INVENTOR
HARRY PETERSSON
BY Fetherstonhaugh & Co
ATTORNEYS

Patented Feb. 7, 1933 1,896,643

UNITED STATES PATENT OFFICE

HARRY PETERSSON, OF MONTREAL, QUEBEC, CANADA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO PETERSSON ALLOYS LIMITED, OF MONTREAL, QUEBEC, CANADA, A CORPORATION OF QUEBEC

PROCESS OF MAKING TUNGSTEN ALLOYS

Application filed August 5, 1929. Serial No. 383,570.

This invention relates to new and useful improvements in the method of and apparatus for casting metal alloys and particularly hard metal alloys containing tungsten, carbide and small quantities of metals such as tantalum, vanadium and the like, and the object of the invention is to provide a simple and inexpensive method for casting such metal alloys to obtain a homogeneous product, which may be used for industrial purposes, such as cutting tools and the like.

Another object is to provide an apparatus in which the alloy charge is melted, thoroughly mixed and then cast without removing said charge from the apparatus.

Many suggestions have been made to use tungsten-carbide for industrial purposes, but great difficulty has been encountered in obtaining a homogeneous product moulded in any desirable form or shape because of the high temperatures which have to be used and the relation between the carbon and the tungsten at these temperatures. It is known that pure tungsten has a very high melting point about 3300° C. so that by producing its carbide in such a shape that it can be used for tool purposes, very high temperatures must be used thereby producing either a sintered or a melted product.

The only crucible material which is able to stand these high temperatures is carbon, but tungsten absorbs a comparatively large quantity of carbon in liquid form at these high temperatures, so that the finished product is not homogeneous and is brittle.

To overcome the above difficulties, my process consists of removing the surplus free carbon from the mix and at the same time subjecting the mix to a mechanical mixing movement.

According to my invention, I provide an electrical furnace having spaced metal electrodes connected by a carbon resistance. Slidably and rotatably mounted within the resistance or heating element is the crucible which is made of carbon. This carbon crucible is divided into two chambers, a mould chamber and a charge chamber separated from one another by a carbon wall, having a plugged orifice. Suitable cooling chambers surround the electrodes and the wall of the heating element.

I make use of the foregoing apparatus in my improved process of making a homogeneous tungsten-carbide alloy. My process consists in placing the charge in the charging chamber when in its horizontal position and heating the said charge to a temperature two or three hundred degrees below the melting point of the tungsten. While the charge is being heated, the carbon crucible is rotated. When the charge has reached this temperature of two to three hundred degrees below its melting point the crucible is swung into a vertical position and then subjected to a mechanical shaking movement. While the charge is being shaken the temperature of the charge is raised to its melting point. Before the charge begins to melt and during the shaking action, a quantity of high metal oxides, pure metal, or both, is added to the charge. The liberated oxygen absorbs carbon from the charge and the carbon tube, as carbon oxide. The oxides hold the percent of carbon within certain limits so that the finished product contains no free carbon or a very small percentage of same. The shaking ensures that the charge is thoroughly mixed and is homogeneous. The plug between the chambers is removed and the tungsten alloy allowed to flow into the mould contained in the mould chamber.

In the accompanying drawing which shows my preferred form of furnace for making tungsten alloys,

Figure 1 is a side elevation of my improved furnace shown partly in section and in the horizontal position, with the water cooling jacket removed.

Figure 2 is a side elevation of my improved furnace shown partly in section and in the vertical position, with the shaker mechanism attached thereto.

Figure 3 is a view of one type of the eccentric for controlling the movement of the shaker mechanism.

Referring more particularly to the drawing, 11 designates supporting brackets adapted to receive the pivot extensions 12 of the outer shell 13 of the furnace. This outer

shell 13 of the furnace has an annular space 14 therein for a cooling agent. A lining 15 of firebrick is provided on the inner wall of the casing. Suitable electrodes 18 are fitted in the upper and lower ends of the lined shell 13, each electrode being provided with an internal chamber 19 to which a cooling fluid is supplied from a source (not shown). It will be noted that the adjacent ends of the electrodes are dished to receive the ends of the graphite heating element 20 to hold it in place. Ground carbon is placed between the graphite element and the inner surface of the lining of the shell. The heating element has a central bore 21 adapted to receive the carbon crucible 22, which is divided into a charging chamber 23 and a moulder chamber 24 by the partition or wall 25. The mould chamber has moulds 26 of any desired shape formed therein communicating with a channel 27 through the apertures 28. This channel extends upwardly through the wall 25 and a suitable plug 29 is placed in said channel to hold the charge in the charging chamber until it is desired to release same. The lower end 30 of the crucible is adapted to rest on a suitable bearing 31 during the tilting movement of the furnace. The upper end 32 of the crucible is connected to a sleeve 33 which extends upwardly through the top electrode and is provided with a groove 34. The electrodes are connected to a source of electrical supply shown diagrammatically as a transformer 35. A switch 36 may be placed in the circuit to the transformer. The electrodes are held in place by any suitable end members 37 and 38 and insulation 39 is provided between the electrodes and the end members. Fitting into the groove at the top of the sleeve 33 is a removable collar 40 mounted within a bracket 41 secured to the end of a rod 42, the other end of which is pivotally secured to an eccentric rod 43. The eccentric 44 is mounted on a shaft 45 rotatably secured in suitable bearings and is of the adjustable type so that the throw of eccentricity may be quickly and conveniently altered to suit the desired movement of the crucible. A typical adjustable eccentric is shown in Figures 2 and 3. It will be seen that the eccentric ring is rotatably mounted in a sleeve member 46 secured to the shaft by bolts 47. These bolts are threaded through the shaft and a spring 48 is placed around each bolt and between the shaft and the inner wall of the sleeve. By moving the bolt, the eccentricity of the sleeve is controlled and the movement of the eccentric ring with respect to the shaft is thus controlled. The rod 42 moves through suitable guides 49 and 50.

In my method of casting tungsten alloys, the crucible is disconnected from the shaking or eccentric mechanism and is swung into the horizontal position shown in Figure 1. Into the charging chamber of the crucible is placed the charge 51 of pure tungsten powder or this powder mixed with tungsten-anhydride WO_3. At a certain temperature the tungsten-anhydride is reduced to metal by taking up carbon from the carbon tube or crucible and after the tungsten-anhydride is reduced to a metal the carbonizing of the pure metal will take place increasing with the temperature. To procure a homogeneous carbon-containing charge, the crucible is revolved during the heating operation while in the horizontal position. This revolution of the crucible may be conveniently accomplished by attaching a crank 33*a* or any other suitable handle means to the sleeve 33. The furnace remains in the horizontal position as shown in Figure 1 until a temperature of some hundred degrees below the melting of the charge is attained. When this temperature has been reached the furnace is then turned on its pivots to the vertical position shown in Figure 2 and the crucible raised and attached to the connecting rod. The crucible is shaken rapidly by means of the eccentric. While the charge is being shaken, the temperature is raised to the melting point. At these temperatures, the tungsten absorbs comparatively large quantities of carbon, which by re-crystallization partially would crystallize as free carbon and so make the product brittle. To prevent this, a predetermined quantity of high metal oxides is mixed with the charge before the casting operation is performed. The liberated oxygen is discharged as carbon oxide taking up a certain percentage of the carbon from the charge. When the reduction of oxides is finished, the partition is pierced and the molten charge is shaken into the moulds. The metal alloy delivered from the charging chamber into the moulds is homogeneous and is dense and possesses an almost negligible quantity of free carbon.

The current is shut off during the casting operation or some time before pouring.

The device is very simple in operation and provides means which may be employed in my improved method of obtaining a dense homogeneous tungsten alloy without removing the charge from the device, thereby reducing the cost of obtaining such alloys to a minimum.

The description has been directed to the process of casting tungsten alloys, but it will be readily understood that other metal alloys may be made by the same process without departing from the spirit of the invention. It must also be understood that metal oxides, or pure metal, or both, may be added to the charge during the shaking action depending upon the characteristics of the material which it is desired to cast.

Having thus described my invention, what I claim is:

1. A method of making tungsten alloys

which consists in placing a tungsten mixture in a charging chamber, subjecting the charging chamber to a violent shaking action and heating the mixture to its melting temperature while retaining said mixture in the charging chamber and then causing the molten alloy to flow into receiving moulds while continuing the shaking action.

2. A method of making tungsten alloys which consists in placing a tungsten mixture in a charging chamber, initially heating the mixture to a temperature below its melting point, subjecting the mixture to a violent shaking action while increasing the temperature thereof to the melting point and then causing the molten alloy to flow into receiving moulds while continuing the shaking action.

3. A method of making tungsten alloys which consists in placing a tungsten mixture in a carbon retort, initially heating said mixture to a temperature below its melting point, increasing the temperature of the mixture to the melting point and simultaneously subjecting the mixture to a violent shaking action, adding a quantity of high metal oxides during the melting of the mixture and while continuing the shaking action and finally causing the molten alloy to flow from the charging chamber into receiving moulds while continuing the aforesaid shaking action.

4. A method of making tungsten alloys which consists in placing a tungsten mixture in a carbon retort, rotating said retort while heating the mixture to a temperature below its melting point, then discontinuing the rotation of the retort and subjecting same to a violent shaking action while increasing the temperature of the mixture to the melting point, adding a quantity of metal oxides to the mixture during fusing thereof and while the mixture is still retained in the charging chamber and then causing the molten alloy to flow into receiving moulds while continuing the shaking action.

5. A method of making tungsten alloys which consists in placing a tungsten mixture in a carbon retort, heating the mixture to the melting point while subjecting the retort to a violent shaking action, adding a quantity of metal oxides to the mixture during the shaking and heating operation in order to reduce the total carbon content of the mixture, the added oxides serving to remove some of the carbon of the mixture as CO and CO_2 while the mixture is absorbing the carbon from its surrounding carbonic atmosphere.

In witness whereof, I have hereunto set my hand.

HARRY PETERSSON.