Sept. 18, 1962 E. J. ZICKEFOOSE 3,054,155

POURING SPOUT AND METHOD OF USING

Filed April 7, 1958

Fig. 1.

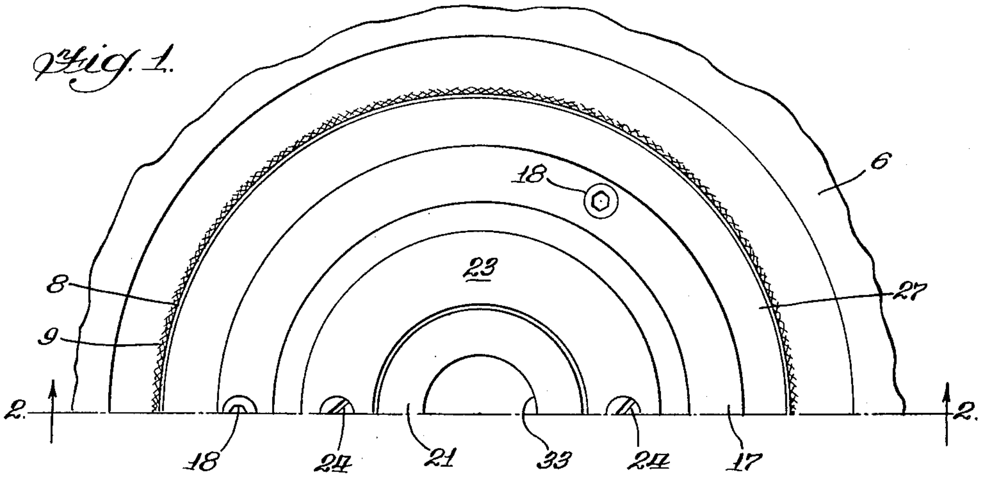
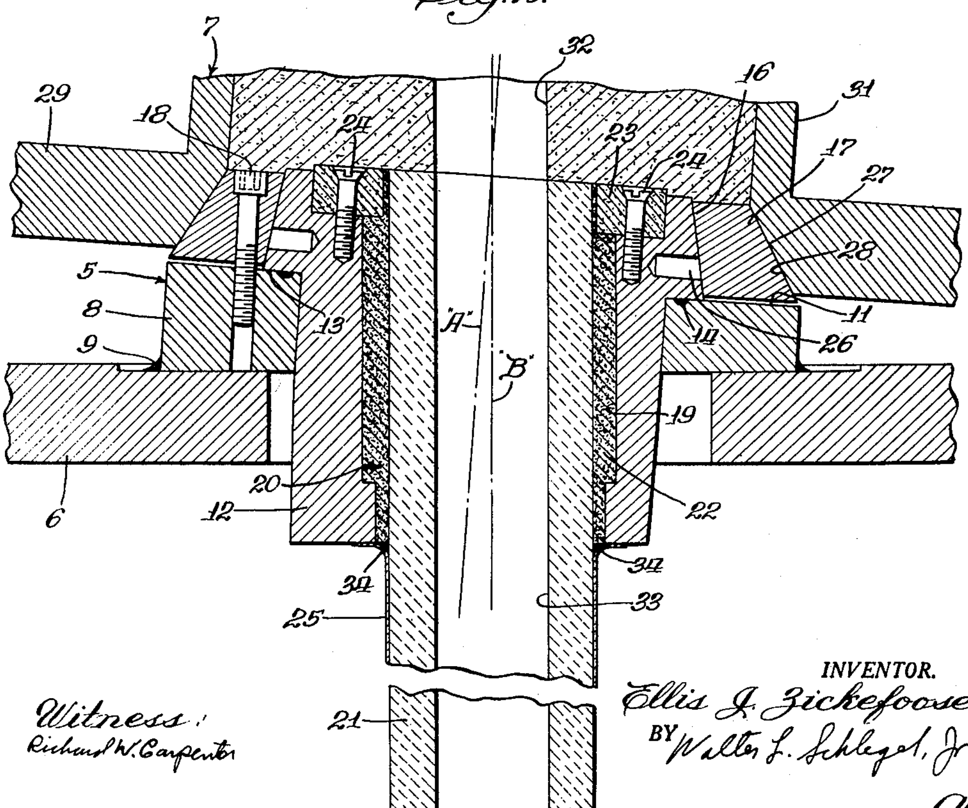


Fig. 2.



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POURING SPOUT AND METHOD OF USING

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This invention relates to the pressure casting of molten metals and more particularly to a method of treating pouring tubes of the type employed in pressure casting operations.

The invention is concerned with the provision of a method for treating a ceramic pouring tube prior to its use in a pressure casting operation in order to render it less susceptible to damage resulting from thermal shock.

As disclosed in applicant's co-pending application, Serial No. 507,055, filed May 9, 1955, now U.S. Patent No. 2,874,424 issued February 2, 1959, in the name of Ellis J. Zickefoose, this invention relates to a pressure casting operation of the type wherein molten metal disposed within a container is forced by the application of fluid pressure thereagainst from the container through a pouring tube into a mold disposed without the container.

Inasmuch as the pouring tubes commonly employed in pressure casting operations of this type are generally formed from a refractory such as an alumino-silicate, they are extremely fragile or frangible and easily broken or cracked when improperly handled, mounted, or otherwise used. This is due, of course, to the nature of these compositions, and particularly to their physical characteristics with regard to thermal expansion, which are largely reponsible for the damage frequently resulting from thermal shock when they are subjected to sudden or excessive temperature changes.

It is, therefore, a primary object of this invention to provide a method of using a frangible pouring tube, formed of a refractory composition, in a manner calculated to materially increase the service life of the tube.

Another object of the invention is to provide a method of treating a ceramic pouring tube to reduce the possibility of its being damaged as a result of thermal shock.

A more specific object of the invention is to provide a particular method of pre-heating a ceramic pouring tube in a manner appropriate to the particular thermal expansion characteristics of the material of which the tube is comprised in order to materially reduce the possibility of damage to the tube resulting from thermal shock due to sudden excessive temperature changes.

These and other objects of the invention will be apparent from an examination of the following description and drawing, wherein:

FIGURE 1 is a top plan view illustrating a pouring tube structure of the type with which my invention is concerned, only one-half of the structure being shown, as opposite halves are identical; and

FIGURE 2 is a vertical sectional view taken along line 2—2 of FIGURE 1.

Referring now to the drawing for a better understanding of the invention, it will be seen that the pressure casting apparatus with which my invention is concerned comprises a pouring tube structure indicated generally at **5**, which is shown as mounted upon a horizontally disposed cover **6** of a sealed container (not shown) adapted to house a ladle (not shown) containing a bath of molten metal (not shown). The molten metal is adapted to be directed upwardly through the pouring tube structure into the casting cavity of a mold **7**, disposed above the container and preferably tilted to prevent the entrapment of air within the casting cavity.

The pouring tube structure **5** is shown as comprising a wedge shaped ring **8**, welded as at **9**, to the upper surface of container cover **6** and presenting an upper surface **11** inclined at an angle of, for example, 3½ degrees from the plane of the cover. The ring **8** is adapted to receive and support for rotational movement a tube assembly comprising a tubular housing **12** and a ceramic tube **21**. The housing **12** is formed with a downwardly facing annular shoulder **13** for abutting engagement against the upper surface **11**. To provide an air-tight seal between the ring surface **11** and the housing shoulder **13**, a ring gasket **14** is interposed therebetween.

The housing **12** is formed with a frusto-conical outer surface **16** extending upwardly from the shoulder **13** for telescopic engagement by a retainer ring **17** secured to the wedge shape ring **8** by means of cap screws **18**. As illustrated in FIGURE 2 in the drawing, the longitudinal axis "A" of the housing **12** is perpendicular to the ring surface **11**, the housing being formed with a bore **19** having its axis "B" disposed at an angle of, for example, 3½ degrees from the axis "A" and perpendicular to the plane of the cover **6**.

The upper end of a ceramic tube **21**, the composition of which is hereinafter described, is disposed within the bore **19** and secured to the housing **12** by means of a suitable wet type air setting refractory **22** comprising, for example, a mix of

	Percent
SiO_2	46
Fe_2O_3	1
Al_2O_3	44
TiO_2	1
Na_2O	3
	95

5% combined water.

The mix **22** is poured into an annular chamber **20** defined between the tube **21** and housing bore **19**, and then dried by heating the housing by means of a flame. During pouring, the mix **22** is retained within the chamber **20** by means of a sealer ring (not shown) positioned and supported against the bottom of the housing **12**, thus preventing leakage of the mix downwardly from the chamber. After the mix has solidified, the sealer ring is removed. The bore **19** and tube **21** are coaxial and perpendicular to the horizontally disposed cover **6**. The mix **22**, mixed to a putty consistency, is used to fill all voids and to form a small fillet **34** at the bottom of the mix junction between the housing **12** and the ceramic tube **21**, thus providing a better seal.

In order to afford a bearing surface between the mold and the top of the housing **12**, a ring or washer **23** preferably formed of graphite or cast iron, may be mounted within the bore **19** and secured in fixed position by means of cap screws **24**. Inasmuch as the outside diameters of the tubes vary slightly, it is desirable to provide the washer **23** with an inside diameter slightly larger than the average outside diameter of standard tubes. The space between the washer and tube may then be filled in with the mix **22**.

After the tube **21** has been cemented to the housing **12**, the outer surface of the tube and the entire outer surface of the fillet **34**, and the junctions of the fillet and the housing, and the fillet and the tube are coated with glaze **25** from the bottom of the housing to within 18 or 20 inches from the lower end of the tube to prevent leakage of air through the wall of the tube into the interior thereof and thence into the molten metal. The glaze **25** may comprise, for example, the following mix:

	Percent
SiO_2	57
Al_2O_3	12
PbO	6
Na_2O	7
K_2O	7
B_2O_3	11
	100

To mount the tube **21** and housing **12** in the cover **6**, the retainer ring **17** is first removed from the structure and the housing is manually rotated about its axis until the longitudinal axis of the tube is normal to the surface of the metal. This can be done by means of a suitable tool or rod inserted into one of the circumferentially spaced sockets **26** provided in the housing. The housing **12** is then secured in its adjusted position by means of the retainer ring **17** and screws **18**.

The retainer ring **17** is formed with an outer frusto-conical surface **27** for snug engagement against a complementary frusto-conical opening **28** formed in the bottom **29** of the drag **31** of the mold **7**, the mold being provided with a gate **32** in registry and axial alignment with the passageway **33** of the tube **21**. When a mold is seated upon the retainer ring **17**, the mold and casting cavity therein are inclined for the purpose of preventing the entrapment of air within the cavity as the latter is being filled with molten metal, as disclosed in said patent application.

In order to insure a satisfactory pouring operation with the above described pressure casting apparatus, it is essential that the pouring tube **21** be formed of a refractory composition.

Although pouring tubes of this type have been formed of various refractory materials, it has been found that the most satisfactory results are obtained by the use of a ceramic tube formed of a refractory such as an alumino-silicate. This invention is not limited in its application to use in connection with a pouring tube of one particular composition, but is concerned with or related to the use of ceramic tubes in general, all of which have a common physical characteristic, namely, that of being extremely frangible and subject to thermal shock; however, in order to better illustrate the invention and its applicability, it is believed that the invention can best be explained by reference to a tube of a known composition.

It has been found that excellent results in a pressure casting operation in the above described nature can be obtained by the use of a pouring tube formed of a refractory such as alumino-silicate comprised of the following ingredients:

	Percent
SiO_2	51–53
Al_2O_3	42–44

Balance—usual ingredients commonly found in fire clay refractories in various percentages, for example:

TiO_2	MgO
Fe_2O_3	Na_2O
CaO	K_2O

Additionally, it has been discovered that the glassy form of silica, known commonly as vitreous silica, serves as an excellent constituent for the above described composition.

It will be understood that a common physical characteristic peculiar to almost all of the above known ceramic compositions is a combination of low thermal diffusivity and a relatively high rate of thermal expansion which renders them extremely sensitive to thermal shocks caused by sudden or excessive temperature changes.

In the pressure casting of molten steel the temperatures at the initial stage of the pour usually reach as high as from 2900° F. to 2950° F. The instantaneous exposure of ceramic pouring tubes to such temperatures is a serious problem because of the high rate of tube breakage due to thermal shock. This breakage increases appreciably the cost of production of steel castings from the standpoint of both replacement and installation of tubes.

Although the basic concept of pre-heating a pouring tube or any other article subject to thermal shock is not new, applicant has discovered a particular method of pre-heating ceramic pouring tubes that afford greater protection against tube breakage, due to thermal shock, than any other pre-heating process known to the applicant.

My invention consists in the provision of a method of pre-heating a ceramic pouring tube, which method includes the following steps: (1) Placing the tube, which has already been mounted in the previously described pouring tube supporting structure, in a pre-heat furnace, the temperature of which is lower than any discontinuity in the thermal expansion curve of the particular composition of the tube. In the case of the composition previously described in detail, the lower critical temperature is 350° F. and the preferable temperature for the initial pre-heat stage is not over 250° F.; (2) Increasing the temperature of the furnace in which the tube is exposed (either by raising the temperature of the pre-heat furnace if only one pre-heat furnace is used, or by sequentially transferring the tube through several pre-heat furnaces in the event a plurality of pre-heat furnaces are used) at a rate of not greater than 200° F. per hour until such time as the tube is at a temperature in excess of any discontinuity in the expansion curve of the composition. In the case of the previously described composition the preferable temperature for the final pre-heating stage is 1800° F.; (3) Transferring the pouring tube supporting structure to the pressure casting apparatus for use in the pressure casting operation; and (4) Upon completion of the pour, returning the pouring tube supporting structure to a pre-heat furnace.

Inasmuch as it is impossible to cement the tube in the housing in the manner described above, after the tube has been heated, it is necessary that the tube first be mounted in the supporting structure before the pre-heating is begun. It is optional, however, whether the housing be mounted within the cover before the pre-heat treatment, as this question is logically determined by the arrangement and type of equipment available in the foundry plant.

One basic reason for pre-heating is to raise the temperature of the refractory body to a level at which at least 50% of the total thermal dilation has occurred and to a heat content closer to that which will be maintained in elevated temperature service.

Accordingly, the real essence of the invention lies in the provision of a method of pre-heating a ceramic pouring tube in sequential stages of uniformly increasing temperature at a rate of increase which will not damage the refractory by thermal shock and to an upper limit as close as practical to the expected service temperature.

It will be understood that the tube can be subjected to the various pre-heating stages in a single pre-heat furnace by changing the temperature of the furnace at regular intervals or by passing the tube through a series of separate pre-heat furnaces, or, of course, by a combination of these systems wherein the final pre-heat furnace is maintained at a constant temperature at all times.

My invention is not limited to the use of any particular one of the above described systems, as regard to the number of furnaces employed, as all of these systems can be utilized to effect the temperature increases required by my invention. It is believed that the choice of systems is most logically determined by the physical arrangement and equipment available in the foundry plant whereat the invention is to be practiced.

I claim:

A method for treating a pouring tube to be used in the pouring of molten metal at a temperature in excess of 2700° F., which tube is formed of a ceramic refractory material in which there are no discontinuities in the thermal expansion curve at temperatures in excess of 1800° F., comprising uniformly increasing the temperature of the tube in sequential stages until the temperature throughout the entire tube is slightly in excess of 1800° F. and at such temperature initiating pouring of the metal.

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