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S. CIESLAK
STOPPER ROD ASSEMBLY

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2 Sheets-Sheet 1

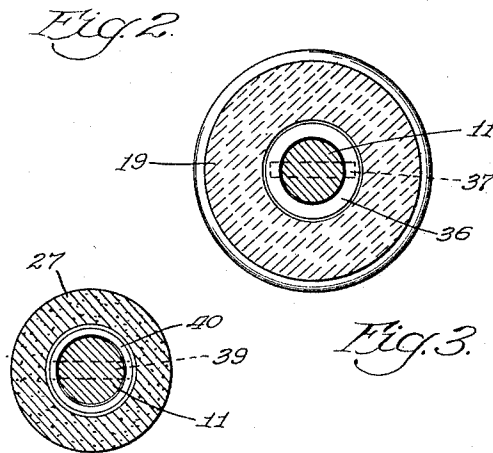
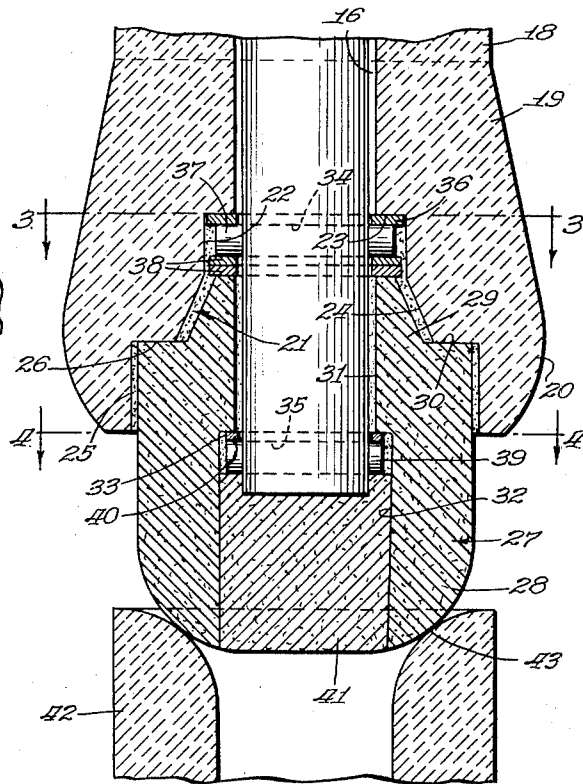
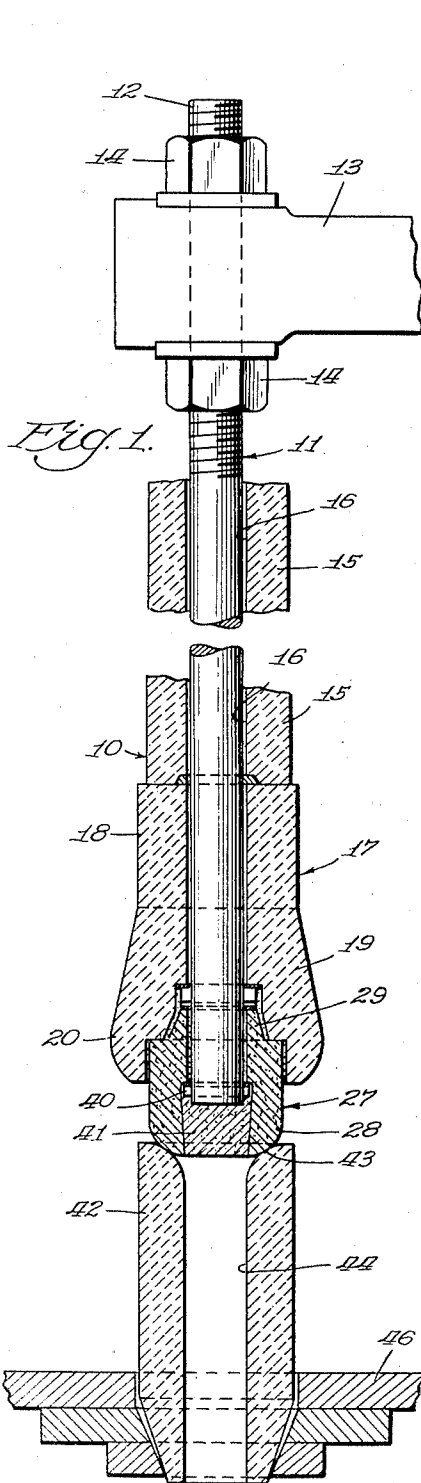


Fig. 4

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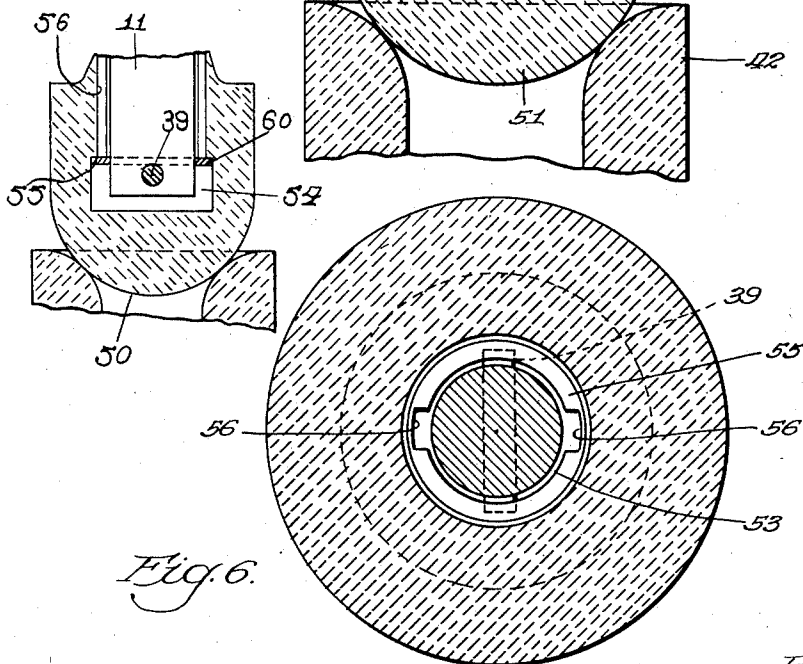
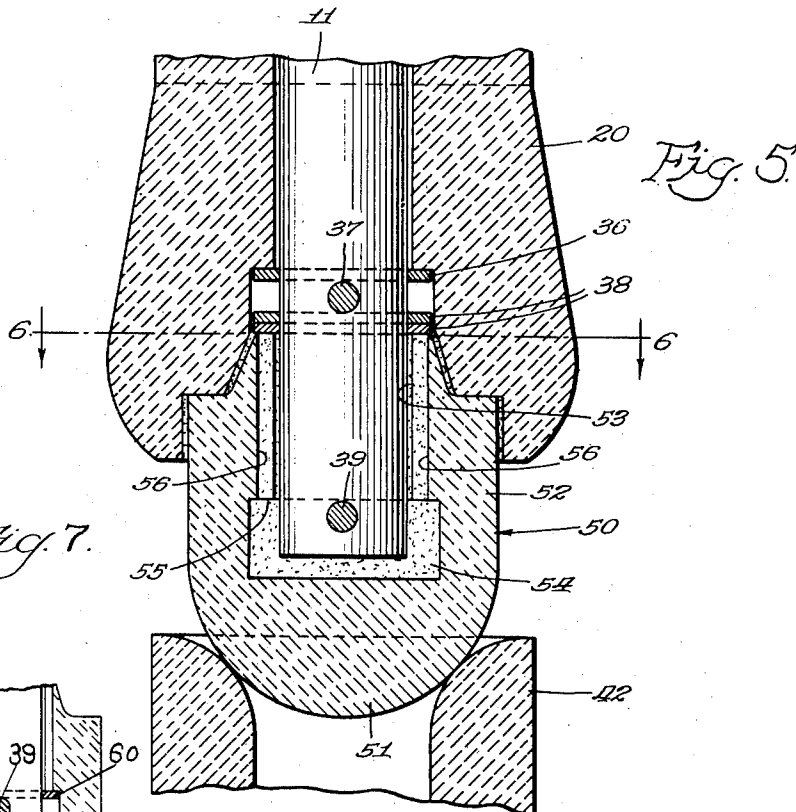
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2 Sheets-Sheet 2



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STOPPER ROD ASSEMBLY

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5 Claims. (Cl. 22-85)

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This invention relates to a ladle stopper and more specifically it relates to a stopper rod assembly for regulating the discharge of molten metal through the discharge orifice of the ladle containing the molten metal. The type of stopper rod assembly with which the present invention is concerned is generally utilized with a metallurgical ladle used for pouring metal into ingot molds. A ladle of this type is generally carried by a crane above the ingot molds. The bottom of the ladle usually has a discharge orifice through which the molten metal may flow and a stopper rod assembly is provided for the purpose of regulating the flow of metal through the discharge orifice. The stopper rod assembly is generally enclosed within a plurality of refractory sleeves which have adjoining ends securely cemented together. The lower end of the stopper rod is provided with a graphite plug or head which is adapted to mate with the discharge orifice for opening and closing the same. The upper end of the stopper rod is generally connected to an operating arm which may be actuated by an operator spaced a distance away from the ladle. Thus as the ladle is moved over the ingot molds, the operator operates the stopper rod assembly for pouring predetermined amounts of metal from the ladle. The stopper rods are generally subjected to a steel bath having a heat of 2600° to 3200° F. In order for the assembly to resist this heat it is necessary to make the plug or head of the stopper rod out of graphite, the refractories themselves generally being made of a fire clay.

The steel industry has experienced many difficulties with the present type of stopper rods. It can readily be seen that the stopper rod assemblies are subjected to an unusual heat condition and that they are more or less rapidly destroyed. The destruction generally takes place at the lower end of the rod near the plug or head thereof. One of the contributing reasons for this is the fact that the strains and stresses resulting from the weight of the many refractories and the pressure thereof by the molten metal in many instances causes a break-down of the graphite head of the assembly. When this occurs the molten metal, of course, can readily reach the stopper rod itself and resultant destruction thereof quickly takes place. The disastrous result of such a destruction can readily be seen, since upon the breakage of the rod and head, the orifice and the ladle cannot be plugged and the operator therefore is unable to control the flow of metal. Generally, the only alternative is to rapidly move the ladle over the ingot

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molds to be filled, with an attempt to reduce the amount of spillage resulting from the lack of control over the discharge orifice.

Numerous types of stopper rod assemblies have been designed with the purpose of finding a solution for this very undesirable condition. Despite improvements, however, it is considered a fortunate and satisfactory result when one of the stopper rod assemblies stands up under a complete pouring operation. The stopper rods are removed from the ladle after pouring has been completed and they are thereupon completely rebuilt. New refractory sleeves and graphite plugs or heads must be provided. The operating rod itself, however, may be used again. In order for the operating rod to carry the unusual loads resulting from the weight of the refractory sleeves, the rods used are generally provided with a shoulder or ledge, which projects outwardly from the ends of the rod and provides a support for the refractories. Such a construction is shown in the Sage Patent 2,296,059. In this manner the main load from the refractories is carried on the rod proper. The plug or head is thereupon fastened to the rod by means of a smaller rod or pin which is secured to the head and is then placed into mating engagement with a vertical bore provided in the lower end of the rod. Under the present practice the stopper rod assemblies are usually returned after use to the blacksmith shop where they are disassembled. In the greater portion of instances, it is found that the lower ledge or shoulder of the rod has been eaten away by the molten metal. Therefore, in order to make such rod usable again, it is first necessary to form a shoulder or ledge on the lower end of the rod. The present practice is to initially cut off the deformed end of the lower rod. A short section of metal is then machined to the diameter of the rod leaving a ledge or shoulder on the short section. This short section of rod is thereupon joined to the main section of the operating rod by means of forge welding or other welding processes. It can readily be seen that it would be impractical to attempt to machine an operating rod of this type since the rod may be anywhere from 15 to 20 feet long. During the machining of the short section of the rod, it is also necessary to again drill a vertical bore into this section in order to provide for the subsequent mating engagement with the pin. Since many pourings may be made daily, and since a new rod assembly is required each time, it should therefore be clearly apparent that the expense of rebuilding the

lower ends of the rods is quite considerable. The machining operations attending the preparation of the short section and the welding of the same to the main section of the rod is obviously an expensive operation.

It is applicant's prime object, therefore, to provide a novel stopper rod assembly, said rod being usable for a number of pourings without the necessity of expensive rebuilding operations.

Still another object is to provide a stopper rod assembly having an improved construction for positively securing a stopper head and lower refractory to the operating rod assembly.

A still further object is to provide a stopper rod having bearing means constructed and arranged to support a plurality of refractories on said rod in a positive manner.

Still another object is to provide a stopper rod having pins projecting laterally outwardly at the lower ends of the rods, said pins being in engagement with annular bearing members in abutment with a lower refractory for the purpose of carrying the weight of a plurality of said refractories on the rod.

A still further object is to provide an improved stopper rod assembly, said rod being re-usable a number of times without the necessity of expensive machining or welding operations.

Still another object is to provide an improved stopper rod head, said head including an imperforate or solid bottom and an improved means for connecting the head to the rod.

Another object is to provide a stopper head for a ladle operating rod assembly, said head including an imperforate or solid rounded bottom and having a bore provided with a pair of opposed recesses, said recesses providing means whereby a rod having projecting pins may be inserted into said head and thereupon rotated, whereby the pins engage undercut shoulder portions of the head thereby securing the head to the rod.

These and other objects will become more clearly apparent from a reading of the description when examined in connection with the accompanying drawings:

In the drawings:

Fig. 1 is a sectional view in elevation through a stopper rod assembly and a portion of a ladle;

Fig. 2 is an enlarged sectional view through the lower portion of a stopper rod assembly;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 2.

Fig. 5 is an enlarged sectional view through a modified form of a lower portion of a stopper rod assembly.

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 5.

Fig. 7 is a sectional view through a modified form of a stopper head.

Referring particularly to Figs. 1 and 2, a stopper rod assembly is generally designated by the reference character 10. The assembly 10 includes a vertical operating rod 11 having a threaded end portion 12, said end portion 12 extending through an operating lever 13 and being connected thereto by means of nuts 14.

The operating rod 11 is enclosed within a plurality of axially adjacent refractory sleeves 15. The refractory sleeves 15 may be made of a frangible material such as fire clay and each includes a bore 16. The lower end of the rod 11 is enclosed by means of a lower or bottom refractory sleeve 17. The sleeve 17 includes an upper section of

uniform diameter 18 and a tapered section 19. The lower end of the tapered section 19 is provided with an annular skirt 20.

The lower end of the refractory sleeve 17 is provided with a recess 21. The recess 21 is in communication at its upper end with a bore 22, said bore being of larger diameter than the bore 16 of the sleeves 15 and 17. The bore 22 forms with the bore 16 a first inner annular shoulder 23. A tapered inner surface 24 is formed below the bore 22 and it in turn is in axial alignment with an enlarged bore 25 which provides an intermediate annular shoulder 26.

A stopper head 27 is shown in Figs. 1 and 2. The stopper head 27 includes a lower rounded portion 28 and an upper portion in the form of a truncated cone 29. The upper portion 29 extends into the recess 21 and an annular ledge 30 of said stopper head 27 is in abutting engagement with the intermediate shoulder 26. The stopper head 27 is provided with a centrally positioned bore 31. The bore 31 is generally of the same diameter as the bore 16 of the refractories. A bore 32 of larger diameter than the bore 31 is in axial alignment with, and provided at the lower portion of the head 27. The bores 31 and 32 form with each other a second annular inner shoulder 33.

The rod 11 has a lower portion extending downwardly through the bores 16 and 31. The lower tip of the rod extends below the second annular shoulder 33. A pair of vertically spaced horizontally or laterally extending openings 34 and 35 are provided in the lower ends of the rod 11. The opening 34 is positioned immediately below the shoulder 23 and the opening 35 is positioned below the shoulder 33. In order to properly support the refractory sleeves on the operating rod 11, a washer or annular bearing member 36 is positioned below and in immediate abutment with the shoulder 23. The rod 11 extends through this washer 36 and a pin 37 extends laterally outwardly through the opening 34 and engages the lower edges of the washer 36. Since the bearing member or washer 36 is seated upon the pin 37, the refractories are thus maintained on the rod. A pair of washers or spacer members 38 are positioned immediately below the pin 37. The spacer members 38 suitably space the pin 37 from the upper end of the head 27. The operating rod, as previously mentioned, extends below the shoulder 33 and a pin 39 extends laterally or transversely outwardly with respect to said rod. A lower bearing member or washer 40 is seated upon the pin 39 and this bearing member or washer 40 is in operative engagement with the second annular shoulder 33.

A plug 41 seals the bore 32, this plug 41 being generally made of graphite cement. As best shown in Fig. 1 the pouring nozzle 42, generally of fire clay, is provided with a valve seat 43. The pouring nozzle has a discharge orifice 44 and is provided at its lower end with a tapered section engageable with a portion of the ladle 46.

During the assembly of the stopper rod assembly 11, the head 27 is first shoved over the end of the rod 11 until the rod projects outwardly beyond the bore 32. At this point a washer or bearing member 40 is threaded over the rod 11 and a pin 39 is driven through the transverse opening 35 thereby maintaining the lower bearing member or washer member 40 on said rod. The rod 11 is now moved until the bearing member 40 is in abutting bearing relation with the shoulder 33. The next step in the assembly is to thread the washers 38 over the upper unfas-

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tened end of the rod 11. After the washers or spacers have thus been placed on the rod 11, the pin 37 is thus driven through the opening 34. The thickness of the washers 38 or spacers is so predetermined that upon the insertion of the pin 37 the head 27 is securely held between the pins 37 and 39. The lower refractory or bottom sleeve 17 is thereupon threaded over the rod 11 and the inner surfaces of the recess 21 are coated with a fire-proof cement whereupon the bottom sleeve is pressed into mating or telescoping relation with the head 27. In this position, as best shown in Fig. 2, it should be noted that the inner annular shoulder 23 is in abutting engagement with the bearing or washer member 36. The other refractories may thereupon be threaded onto the rod 11, a suitable refractory cement being cemented between the ends of each of the refractories in order to eliminate possible entrance of the molten metal between the joints of the refractories. After the rod has thus been assembled, a graphite cement is poured into the opening 32 for producing the plug 41 to seal the opening.

It can now be seen that a novel stopper rod assembly has been provided which will clearly achieve the objects set forth above. By the construction shown, the weight of the refractories is for the major part supported on the pin 37 which projects laterally outwardly of the rod 11. In this manner the stresses occasioned by the weight of the refractories and the pressure of the molten metal are not completely carried by the graphite head or plug which must perform the important function of sealing the orifice of the ladle. The graphite head 27 is also rigidly secured to the rod by means of the pin 39 and the washer or bearing member 40. The washer or bearing members 35 and 40 serve to equalize the pressures on the surfaces of the pins 37 and 39, thereby reducing the possibility of fracture of the sleeve or graphite head. In the event that molten metal seeps into the recess of the sleeve or bores of the head and thereby destroys a portion of the lower end of the rod it would be a simple expedient to merely cut off the deformed section immediately below the upper transverse opening 34. In order to repair this rod for subsequent use, all the operator must then do is to drill a similar opening a spaced distance above the remaining opening. It should be clear therefore that the two transversely extending openings are again provided and the rod may be re-used. In a rod of this type it is not necessary to perform expensive machining operations and all that may be required is the drilling of a single hole in order to prepare the rod for re-use. It is less likely that the graphite head 27 will become displaced or broken away from the lower end of the rod, since a positive and permanent connection has been provided. A rod construction of this type can clearly be re-used in an inexpensive and efficient manner.

Figures 5 and 6 show a modified form of the invention. In order to minimize the conditions under which the molten metal may seep into contact with the rod, and in order to secure a more satisfactory stopper head, it is desirable to make the head with an imperforate or solid lower portion. In the modified form of the invention shown a head 50 includes a lower rounded portion 51, said portion being imperforate or solid. An upper portion 52 projects upwardly into the recess 21 in the same manner as the head 27. The head 50 is provided with an axially extending

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bore 53 which is intersected by a cylindrical space 54. The space 54 is of larger diameter than the bore 53 and therefore provides an undercut shoulder 55. The bore 53 is also provided with a pair of axially extending opposed recesses 56 which extend the length of the bore.

It is of prime importance to note how this construction facilitates assembly of the parts. The member 36 is threaded onto the rod. Thereupon the spacers 38 are threaded onto the rod and the pin 39 is inserted into opening 35. The pin 39 projects outwardly from the rod 11. The lower end of the rod is inserted into the bore 53 and the pin 39 slides axially downwardly in the recesses 56 until the pin is within the cylindrical space. The mechanic then rotates the rod, or head, approximately ninety degrees, whereupon the pin 39 engages the undercut shoulder 55. The operator now slips the washers 38 into abutment with the head. He then inserts pin 37 through the opening 34 whereupon the head is tightly and securely locked to the rod. Suitable fire-proof cement has previously been poured into the head to produce a tight joint between the head and the lower end of the rod.

The head is now rigidly secured to the rod and the solid lower portion of the head prevents the possibility of molten metal entering and destroying the lower end of the rod. In view of this construction a head of greater durability is provided and expensive operations are eliminated by the novel means of connecting the head to the rod.

Fig. 7 is another modified showing of the stopper head 50. In this showing a metal washer or bearing member 60 is positioned against the undercut shoulder 55. The washer 60 provides a hard wearing surface for the pin 39. The washer 60 is formed integrally with the head 50 during its manufacture, the head generally being cast. The washer 60 therefore may be cast into the head whereupon it is securely fixed to the shoulder portion 55, or if the head is made in several parts, the washer may be cemented to the shoulder portion 55. Since the metal washer is of a substantially harder material than the head, a good wearing surface for the pin 39 is provided.

It is to be understood that preferred and modified embodiments of the invention have been shown and various changes and other modifications may be made which do not depart from the spirit of the invention as disclosed nor the scope thereof as defined in the appended claims.

What is claimed is:

1. In a ladle stopper having an operating rod enclosed within a plurality of refractory sleeves; the combination therewith of a refractory bottom sleeve having a centrally disposed enlarged recess at its lower end providing an annular shoulder, a stopper head having an upper portion engaging the recess of said bottom sleeve in mating relation and having a portion projecting outwardly from the recess, said stopper head including a centrally disposed bore telescopically engaged by the lower end of said operating rod, means securing the bottom sleeve and said stopper head to said operating rod including a first washer threaded on the rod and abutting the annular shoulder, an upper removable pin extending transversely through the rod, said upper pin engaging the washer in supporting relation, a second washer threaded on the rod, said washer being positioned between the upper pin and the upper portion of said stopper head, and a lower pin removably connected to said operating rod,

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said pin projecting transversely outwardly from the rod for engaging said stopper head.

2. In a ladle stopper having an operating rod enclosed within a plurality of refractory sleeves; the combination therewith of a refractory bottom sleeve having a centrally disposed enlarged recess at its lower end providing an annular shoulder, a stopper head having an upper portion engaging the recess of said bottom sleeve in mating relation and having a portion projecting outwardly from the recess, said stopper head including a centrally disposed bore telescopically engaged by the lower end of said operating rod, means securing the bottom sleeve and said stopper head to said operating rod including a first washer threaded on the rod and abutting the annular shoulder, an upper removable pin extending transversely through the rod, said upper pin engaging the washer in supporting relation, and a lower pin removably connected to said operating rod, said pin projecting transversely outwardly from the rod for engaging said stopper head.

3. In a ladle stopper having an operating rod enclosed within a plurality of refractory sleeves, the rod having upper and lower transversely extending openings at its lower end; the combination therewith of a refractory bottom sleeve having an enlarged recess at its lower end providing a shoulder, a stopper head having a first portion engaging the recess of said bottom sleeve in mating relation and having a second portion projecting outwardly from the recess, said stopper head including a bore telescopically engaged by the lower end of said operating rod, means securing the bottom sleeve and said stopper head to said operating rod including an upper removable pin positioned in the upper opening of said rod, said pin having a portion extending outwardly of the rod for engaging the shoulder of said bottom sleeve in supporting relation, and a lower pin positioned within the lower opening of the rod, said pin having a portion projecting outwardly of the rod for engaging a portion of the head in supporting relation.

4. In a ladle stopper having an operating rod enclosed within a plurality of refractory sleeves, the rod having a transversely extending opening adjacent its lower end; the combination there-

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with of a refractory bottom sleeve having an enlarged recess at its lower end providing a shoulder, a stopper head having an upper portion engaging the recess of said bottom sleeve in mating relation and a lower portion projecting outwardly from the recess, said stopper head including a bore telescopically engaged by the lower end of said operating rod, means securing the bottom sleeve to said operating rod including a pin removably positioned in the transverse opening of the rod, said pin having a portion projecting outwardly of the rod for engaging the shoulder of the bottom sleeve in supporting relation, and supporting means between the stopper head and the rod for connecting said head to the lower end of said rod.

5. In a ladle stopper having an operating rod enclosed within a plurality of refractory sleeves, the rod having a transverse opening adjacent its lower end; the combination therewith of a refractory bottom sleeve having a recess at its lower end, a stopper head having a first portion engaging the recess of said bottom sleeve in mating relation and having a second portion projecting outwardly from the recess, said stopper head including a bore telescopically engaged by the lower end of said operating rod, means for securing the stopper head to said rod including a lower pin connected to said rod, said pin having a portion projecting outwardly of the rod for engaging the stopper head, and an upper pin removably positioned within the transverse opening of said rod, said pin having a portion projecting outwardly of the rod for engaging the first portion of said stopper head in secure supporting relation.

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