(No Model.)

C. S. PRICE.

NOZZLE FOR STEEL LADLES.

No. 410,192. Patented Sept. 3, 1889.

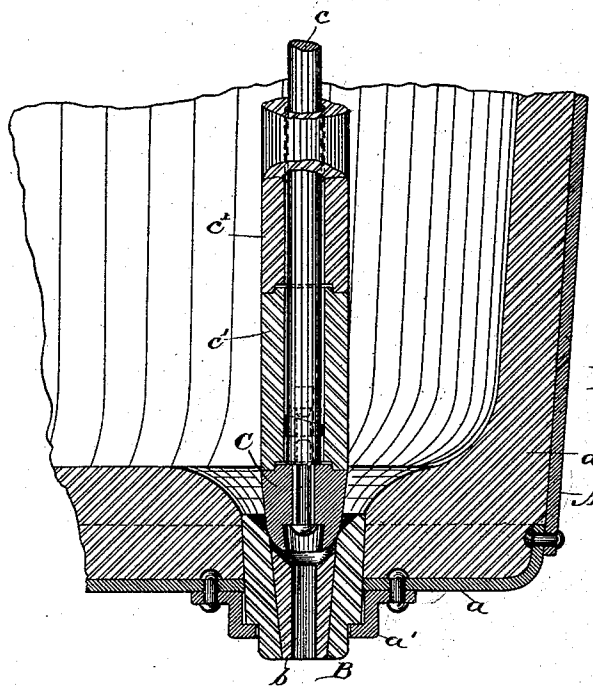

Fig. 1.

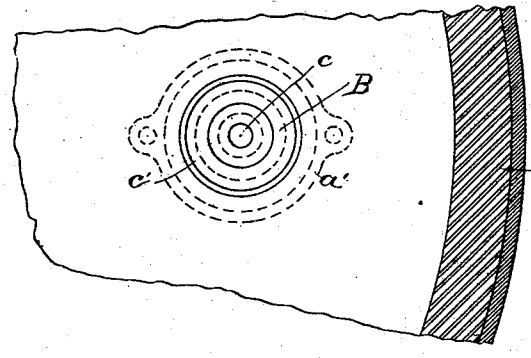

Fig. 2.

WITNESSES.

E. J. Burkhart.
A. C. Newman.

Charles S. Price. INVENTOR.

UNITED STATES PATENT OFFICE.

CHARLES S. PRICE, OF JOHNSTOWN, PENNSYLVANIA.

NOZZLE FOR STEEL-LADLES.

SPECIFICATION forming part of Letters Patent No. 410,192, dated September 3, 1889.

Application filed May 2, 1889. Serial No. 309,349. (No model.)

To all whom it may concern:

Be it known that I, CHARLES S. PRICE, a citizen of the United States, residing at Johnstown, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Nozzles for Steel-Ladles; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

In the art of making steel other than crucible steel as practiced in the large steel-works it is customary to pour the steel into the molds from a ladle, and it has been found expedient to pour from the bottom of the ladle by opening a suitable orifice. This orifice is formed by a piece of refractory material, called a "nozzle." The nozzle is usually circular in shape, with a central opening. The upper part of this opening is usually in the form of an inverted cone, adapted to receive a piece of plumbago or other refractory material, called a "stopper." This stopper is operated by a rod extending through the molten mass of the metal. The rod is protected from the heat of the molten metal by means of refractory sleeves, which are placed over it. The form of the central opening in the nozzle is very material to the quality of the product. In the first place, the opening must be smooth and free from grooves or projections, as any irregularity in the shape of the nozzle scatters the stream of steel and causes particles of air to be carried with it into the mold. Aside from this, it is found that the stream should be as nearly circular as possible, so as to have the minimum amount of surface exposed to the atmosphere for the purpose of preventing oxidation. Besides this, a certain-sized stream relative to the size of the mold is desirable for practical reasons well known to steel-makers.

Heretofore it has been the practice to form the nozzle of a single piece of material, which is built up as part of the refractory lining of the bottom of the ladle, and it was possible to so make a nozzle that would give very good results at first; but as a nozzle made of any known material is soon eroded by the flowing metal, after pouring one ladleful of steel the nozzle is not in perfect condition for the succeeding ladlefuls. As the refractory lining of the ladle will stand the heat and erosion of many ladlefuls of steel, the nozzle has been the weak point.

My invention relates to means for overcoming the objections heretofore experienced; and the object of my invention is to prolong the life of a ladle and make it possible to secure uniformly good quality of the product.

My invention consists in a nozzle formed in two parts—an outer and an inner part—circular in a horizontal cross-section and concentric with each other. The outer part is built in with the refractory lining of the bottom in the usual way, and the upper part of it is formed in the usual way, to act in conjunction with the stopper to regulate the flow of metal. The central opening through this outer part is conical in form, its larger diameter being at its upper part. Fitting this outer part is the inner part—that is, a conical exterior surface of the inner part fits a conical interior surface of the outer part. The inner part is provided with a central hole of proper size and shape to act as an orifice for the molten metal to flow through. The orifice in the inner part is cylindrical in shape throughout the greater part of its length; but the upper part of this orifice expands into an inverted cone, so as properly to deflect the metal. The surface of this cone near the outer part of the nozzle while in place is slightly below the surface of the outer part, upon which the stopper rests, so that the stopper never comes in direct contact with the inner part of the nozzle.

The advantage of my invention is, that the inner part of the nozzle can be easily replaced when eroded.

I am aware that the old nozzle heretofore in use can be replaced without removing the lining of the ladle; but the operation is a very tedious and difficult one, and cannot be done without somewhat delaying the operation of the mill, whereas the inner part of my nozzle can be replaced without any delay, and a clean new orifice may be readily provided for each ladleful of steel. After the steel has all run out of the ladle it is the practice to remove the stopper entirely from the ladle and turn the ladle upside down to pour out the cinder and scale which remain after the metal

is poured out. While the ladle is in this inverted position an operator knocks out the inner part of my nozzle, and when the ladle is again turned to its upright position a new inner part is dropped in place before the stopper is inserted.

In a practical trial of my invention I have found that the outer part of my nozzle has a life equal to the refractory lining of the ladle.

To make my invention more clear, I will now refer to the annexed sheet of drawings, which forms part of this specification, and in which—

Figure 1 is a vertical section through my nozzle, showing the usual stopper and sleeves and part of the bottom and side walls of a steel ladle. Fig. 2 is a plan of the same, with a part of the side wall of the ladle in section and with the stopper omitted.

A represents the outer shell of a steel-ladle such as is used in our large open-hearth and Bessemer steel works. *a* represents the bottom of said shell.

a' represents a circular cast piece of the form shown in the drawings, which is riveted onto the bottom part of the ladle-shell. The office of this piece *a'* is to support the outer part of my nozzle in a similar way to the manner of supporting the old style of nozzle.

a^2 represents the refractory lining of the ladle.

B represents the outer part of my improved nozzle. It will be seen by referring to Fig. 1 that the outer part of my nozzle B has a shoulder formed on its lower outer part to bear on the circular flanged casting *a'*. The outer surface of the outer part of the nozzle is made slightly conical to admit of its more easy removal should occasion require it.

b represents the inner part of my nozzle, as will be seen in the drawings. The inner part *b* is adapted to fit the outer part B by the contact of conical or taper surfaces. This construction provides for the ready removal of the inner part *b* by pushing it upward, or, when the ladle is inverted, pushing it downward.

C represents the stopper; *c*, the stopper-rod, connected to it by the usual construction, which consists in a bolt passing through a central countersunk hole in the stopper and into a central hole in the stopper-rod, the bolt being held in place in the stopper-rod by a flat taper key, as shown by the dotted lines in the drawings.

c' represents the usual refractory sleeves placed around the stopper-rod to protect it from the heat of the molten metal. It will be noticed that the stopper C registers with the upper part of the outer part B of my nozzle, and that it does not come in contact with the inner part of my nozzle *b*.

Having described the several parts of my invention, the manner of working it is as follows: We will consider the ladle as having the outer part of my stopper B in place and the refractory lining inside of the ladle. The inner part of my stopper *b* is dropped in place, it being first washed with moist clay. The stopper C, assembled with its rod and sleeves, is then inserted and the ladle is ready to receive its burden. The melted steel is now poured from the converter or furnace into the ladle and the ladle transported to the proper position, so that its nozzle will be vertically over the mold. The stopper is now raised by its rod and the usual mechanism, (not shown in the drawings and which forms no part of my invention,) thus opening an annular space between the stopper C and the outer part of the nozzle B. The molten metal flows through this annular passage and is converged by the upper conical surface of the inner part of my nozzle *b*, and finally flows in a solid stream through the central cylindrical opening of the inner part *b* of my nozzle, and is thence deposited in the mold. When the mold is filled, the stopper C is lowered, thus closing the opening and the ladle transported to the next mold. This operation is continued until the metal is all exhausted from the ladle, whereupon the ladle is transported to the proper position over a cinder-car, the lifting mechanism of the stopper C is detached, and the stopper C, with its rod and sleeves, is removed bodily from the ladle. The ladle is then inverted over the cinder-car, so as to dump its cinder, and while in its inverted position the operator, by means of a slight rapping, loosens the inner part *b* of my nozzle, when it drops down, with the cinder, into the cinder-car. The ladle is then turned right side up, a new inner part *b* is inserted, the stopper again put in position, and the operation repeated.

The great advantage of my invention will be made apparent by the fact that of late specifications for steel rails have required that the stream of steel running into the ingot-molds shall be small, round, and free from scattering or spreading tendency, and inspectors are sent by the railroad companies to witness the pouring of the ingots to see that these conditions are complied with. It might be thought that the refractory lining of the ladle might be extended to take the place of the outer part of my nozzle B; but this would be impracticable, because such lining would not form a proper bearing for the stopper, and if the stopper be made to bear directly on the removable part of the nozzle the union between the removable part of the nozzle and the walls of the ladle would be exposed to the continuous heat and erosion of the molten steel and would become so thoroughly cemented in place that it would be difficult to remove. Furthermore, it is a necessity to have the removable part of the nozzle as small as possible, because, first, the part thrown away at each ladleful of steel is less expensive, and, second and principally, because if large the amount of luting material required is so great

that it would not be safe to pour a new ladleful of hot steel upon it, as it might result in a terrible explosion.

Delays occur sometimes in the pouring operation at a steel-mill, caused by breaks in the transporting machinery or other accidents, and the molten steel may be chilled in the nozzle. When this occurs, the operation called pricking is resorted to, which is as follows: A short pointed iron bar is placed on a support under the ladle, so that its point will rest on the chilled nozzle, and the ladle is lowered upon it, thus forcing an opening into the ladle. This operation usually carries the whole nozzle up into the ladle, tearing out part of the refractory lining and making a large irregular opening, out of which the steel spouts in an uncontrollable stream. As bad as this result is it has been the most economical thing to do, for if this operation were not resorted to the whole ladleful would become solid. In cases like this the operation of pouring over the top of the ladle is too dangerous to be admissible. In my improved nozzle the pricking operation is less objectionable, as the inner part of the nozzle only is removed by the pricking, and the stopper still performs its office on the outer part of the nozzle.

Having fully described my improvement and the manner of working the same, what I claim as my invention, and desire to secure by Letters Patent, is—

1. In a ladle for receiving and pouring hot steel, a refractory nozzle composed of two parts, an outer and an inner part, the inner part being detachably fitted to the outer part by conically-fitting surfaces for the purpose of allowing the inner part to be readily replaced, in combination with a stopper contained within the ladle and operated by means of a rod extending through the molten metal, the said stopper having its bearing upon the outer part of said nozzle, substantially as and for the purpose set forth.

2. In a ladle for containing and pouring molten steel, a nozzle composed of two parts, an outer and an inner part, the outer part being cemented to the refractory lining of the ladle and being provided with an interior conical surface, the inner part being provided with an exterior conical surface adapted to fit the interior conical surface of said outer part, the inner part being also provided with a cylindrical orifice through its center, for the purpose of permitting the passage of a clean solid stream of steel, the upper part of said cylindrical orifice being formed in the form of an inverted cone, for the purpose of converging the molten steel, so that it will form itself into a solid stream while passing through the said cylindrical part of the orifice, in combination with a stopper contained within the ladle and actuated by means of a rod passing through the molten steel contained within the ladle, said stopper being adapted to bear and fit upon the upper portion of said outer part of said nozzle and said stopper when in contact with said outer part of said nozzle not being in contact with said inner part of said nozzle, substantially as and for the purpose set forth.

3. In a ladle for containing and pouring steel, a nozzle composed of two parts, an outer and an inner part, the outer part being cemented to the refractory lining of the ladle, the inner part containing the orifice through which the steel passes and being detachably fitted to the outer part, for the purpose of being readily replaced, in combination with a stopper contained within the ladle and actuated by a rod extending through the ladle adapted to close the passage through which the metal passes while being poured, substantially as and for the purpose specified.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES S. PRICE.

Witnesses:
F. J. SHAFFER,
W. J. ECKEL.