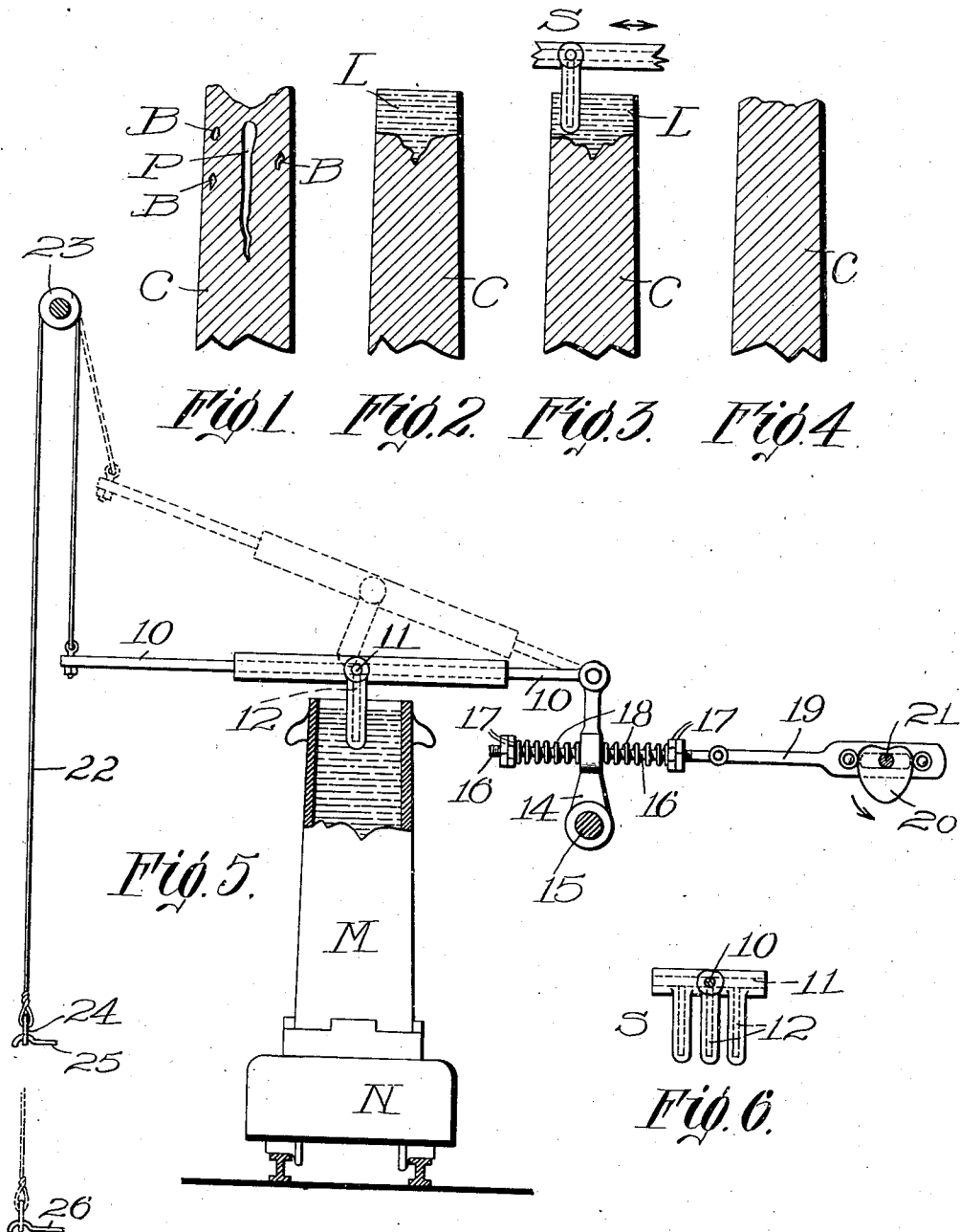


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METHOD OF MAKING INGOTS.
APPLICATION FILED MAY 21, 1909.

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Patented Jan. 6, 1914.



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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING INGOTS.

1,083,379.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, LOUIS W. SOUTHGATE, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Method of Making Ingots, of which the following is a specification.

In casting ingots, particularly the ingots used in the steel industry, difficulty is encountered in obtaining a cast free from imperfections and cavities. The cast solidifies first at the sides from the bottom upward and crusts over on the top. As the sides of the cast solidify or freeze, the center remains liquid or semi-liquid and as shrinkage occurs a cavity called a pipe forms at the top central part of the cast which pipe extends down into the cast some considerable distance. These cavities or pipes usually will not weld or heal as the ingot is rolled. The crust which forms on the top of the cast is liable to prevent the escape of occluded gases and for this reason blow holes or cavities are apt to form in the upper part of the cast. The difficulties are so serious that it is the present practice in steel mills to crop the ingot, that is, to roll the same down partially and then cut off a section thereof corresponding to the upper end of the cast. This cropped end has to be remelted and thus the heat and work connected therewith is lost. But more serious than this loss, is the liability that the imperfections may extend down below the part of the ingot which is cropped off and discarded. Thus for example, in a rail mill if twenty per cent. of the ingot is cut off, there is no surety that all the flaws are eliminated, and if all the flaws are not eliminated the rail will be defective near its end. For this reason there is a great deal of controversy between steel mills and railroads about the amount of cropping, the railroads insisting on the cropping of a large section of the ingot which the steel mills hesitate about on account of the loss.

Various methods have been suggested for preventing piping but so far as I am aware no satisfactory solution of the problem of making a better cast has been reached. One proposed method is to apply heavy pressure as by hydraulic machinery to the cast as it solidifies. This method is very expensive as it involves heavy molds, hydraulic apparatus and appliances, and retards production. The method so far as I am informed has never come into use except in special instances where the necessity of making a bet-

ter cast more than balances the great cost. Another method that has been proposed is to keep the top of the ingot molten for a long time so that the tendency to crust over the top will be retarded and so that the molten metal at the top can settle down and fill the pipe as the same forms. This method has been practised by applying a gas flame on top of the ingot to prevent the same solidifying. This is expensive and is apt to spoil the top of the mold. Another way of carrying out this method is by protecting the top of the mold by heat insulators but so far as I am informed this has not proved very satisfactory. Another way of carrying out this method is by arranging a series of molds so that one will pour or drain into the next whereby molten metal will be supplied for a considerable time to the tops of the molds. This method is uncertain, requires special molds, and only acts to improve part of a series of casts.

I have discovered that the method of making a cast by keeping the top part thereof molten for a long time can be carried out by agitating or stirring the molten metal at the top of the cast while the body of the metal solidifies. This will prevent the formation of a top crust and will keep the metal at the top molten for a long time so that the same can act to fill the pipe by gravity. This improved method may be practised very economically in connection with the apparatus used in any ordinary steel or rail mill.

In the accompanying drawing: Figure 1 is a sectional view illustrating an ordinary cast or ingot C with a pipe P and blow holes B—B. Fig. 2 is a similar view illustrating how a body of molten metal L at the top acts to fill up any tendency to pipe and to prevent any crusting over of the top to retain the occluded gases in the cast. Fig. 3 is a similar view illustrating how a stirrer or agitator may be employed to keep the metal at the top of the mold in molten condition in accordance with my invention. Fig. 4 is a similar view of a cast made by my improved method. Fig. 5 is a diagrammatic view illustrating one form of mechanism for practising my invention, and Fig. 6 is an end view of the stirrer or agitator.

I have shown my method as applied to the molds M used for casting ingots in a rail mill. Two of these molds are usually mounted on a car N, which molds are run under a pouring pot or ladle and filled. The stirrer or agitator S is represented as

made in the form of a rake. This rake consists of a bar 10, cross bar 11, and downwardly extending rods or teeth 12. Cylinders of fire clay are arranged on the bars 10 and 11 and teeth 12 to prevent burning or melting of the same. The rod 10 is pivoted at one end to a lever 14 loosely mounted on a pivot or shaft 15. Passing through the lever 14 is a rod 16 having nuts 17—17 threaded on its ends. Springs 18 are arranged between the lever 14 and nuts 17. The rod 16 is connected to a yoke 19 which has rollers engaging cam 20 on shaft 21. By this mechanism if the shaft 21 is rotated the lever 14 will be rocked or vibrated. It also will be noticed that an adjustable spring relief is afforded by means of the springs 18—18 whereby if the stirrer sticks, breakage will not occur. The other end of the rod is supported by a rope 22 passing over an over head pulley 23. The other end of the rope is provided with a ring 24 which may engage hooks 25 or 26. A number of these mechanisms may be arranged in line on shaft 15 and may be driven from shaft 21, if it is desired to practice the method with a plurality of molds such as the ordinary train of cars carrying molds filled from a charge of the pouring ladle.

The method is practised as follows: After the mold is poured the car carrying the same is run to a position opposite the stirrer S. The stirrer is then lowered into the mold M by the rope 22 and is left to reciprocate with its teeth projecting into the molten metal as long as desired. This will keep the metal in the strata operated upon by the stirrer in an agitated condition, and will prevent any crusting or solidifying over the top of the cast. The occluded gases can escape so long as the stirring operation continues. While this stirring operation is taking place the ingot is solidifying below said strata from the outside toward the center, and from the bottom toward the top. The strata of metal operated upon by the stirrer being kept in an agitated condition and being prevented from solidifying, at the end of the operation, there will remain a layer of molten metal at the top, and a partially solidified ingot below, and this molten strata will act to correct any tendency to pipe as the ingot completely solidifies thereafter. Thus the character of the cast can be improved and the method adds very little, if anything, to the cost. The ingot made by this method will be much improved in character and cropping can be reduced or possibly eliminated.

Many other forms of apparatus may be worked out for practising the invention without departing from the scope of the invention as expressed in the claims.

Having thus fully described my invention what I claim and desire to secure by Letters Patent is:—

1. The method of preventing piping in ingots which consists in stirring the molten metal at the top of the cast to keep the same molten while the body of the cast sets or solidifies.

2. The method of making ingots which consists in filling a mold with molten metal and agitating or stirring the metal at the top of the mold while the metal below remains unagitated so that the metal at the top of the mold will be kept in liquid form to fill the pipe or shrinkage cavity.

3. The method of making ingots, which consists in filling a mold with molten metal, and agitating or stirring the metal laterally at the top of the mold to keep the same molten while the body of the cast sets or solidifies.

4. The method of making ingots which consists in pouring molten metal into a mold and agitating or stirring the top strata of the metal laterally to keep the same molten while the body of the cast below sets or solidifies.

5. The combination of a mold, of a stirrer which can be inserted in the top of the same, and means for reciprocating the stirrer side-wise of the mold.

6. The combination of a mold, of a pivoted stirrer which can be inserted in the top of the same, and means for reciprocating the stirrer sidewise of the mold.

7. The combination of a mold, a stirrer made in the form of a rake having its teeth protected with fire clay, and means for moving the rake.

8. The combination of a mold, an agitator for stirring the metal at the top of the mold comprising a rake pivoted to a lever mounted on a shaft, and means for oscillating the lever.

9. The combination of a mold, means for agitating the metal at the top of the mold consisting of a rake, a lever loosely mounted on a shaft to which lever said rake is connected, and means for vibrating said lever, said means having a spring relief.

10. The combination of a mold, and means for agitating the metal at the top of the mold, consisting of a rake, a cord or rope for supporting one end of the rake so that the same can be lowered into the mold, and means for reciprocating the rake.

In testimony whereof I have hereunto set my hand, in the presence of two subscribing witnesses.

LOUIS W. SOUTHGATE.

Witnesses:

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