J. E. YORK.

SOLIDIFYING INGOTS.

APPLICATION FILED OCT. 25, 1907.

1,035,933.

Patented Aug. 20, 1912.

3 SHEETS—SHEET 1.

FIG. 1.

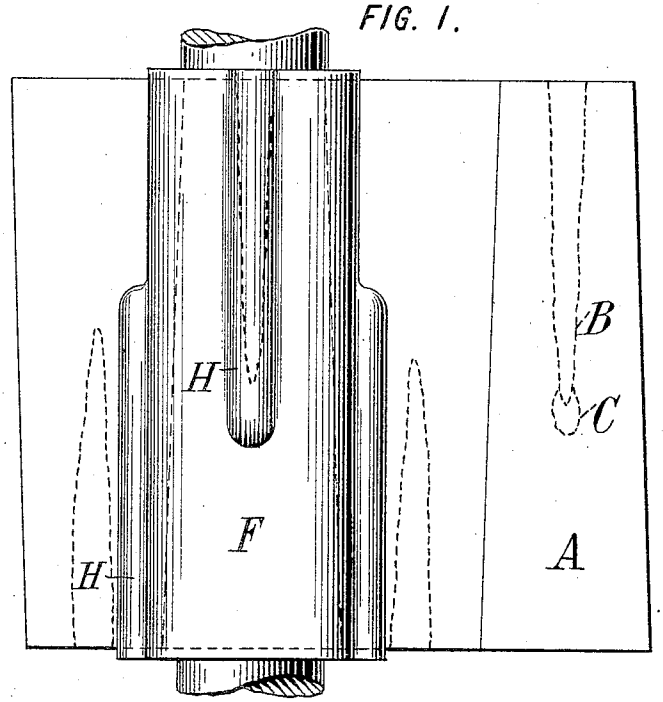
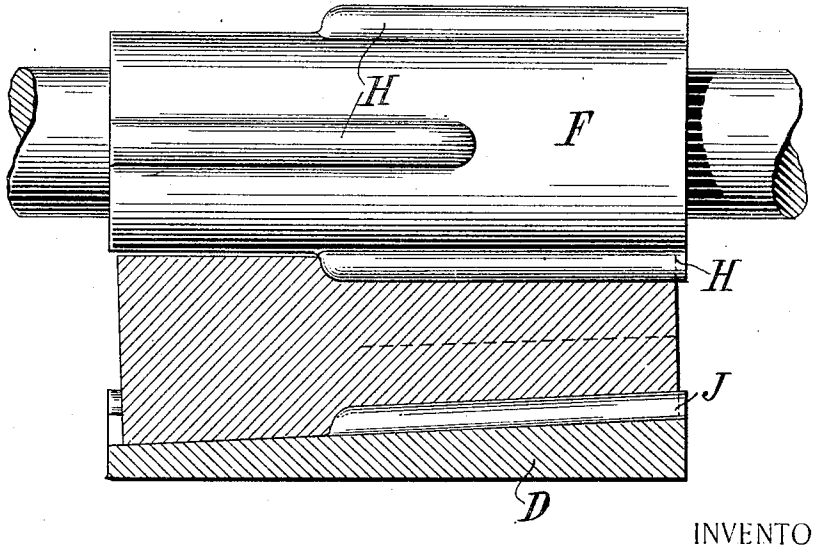


FIG. 2.



INVENTOR

James E. York,

By Attorneys

Arthur & Robert Moore

WITNESSES:

Fred White

René Muine

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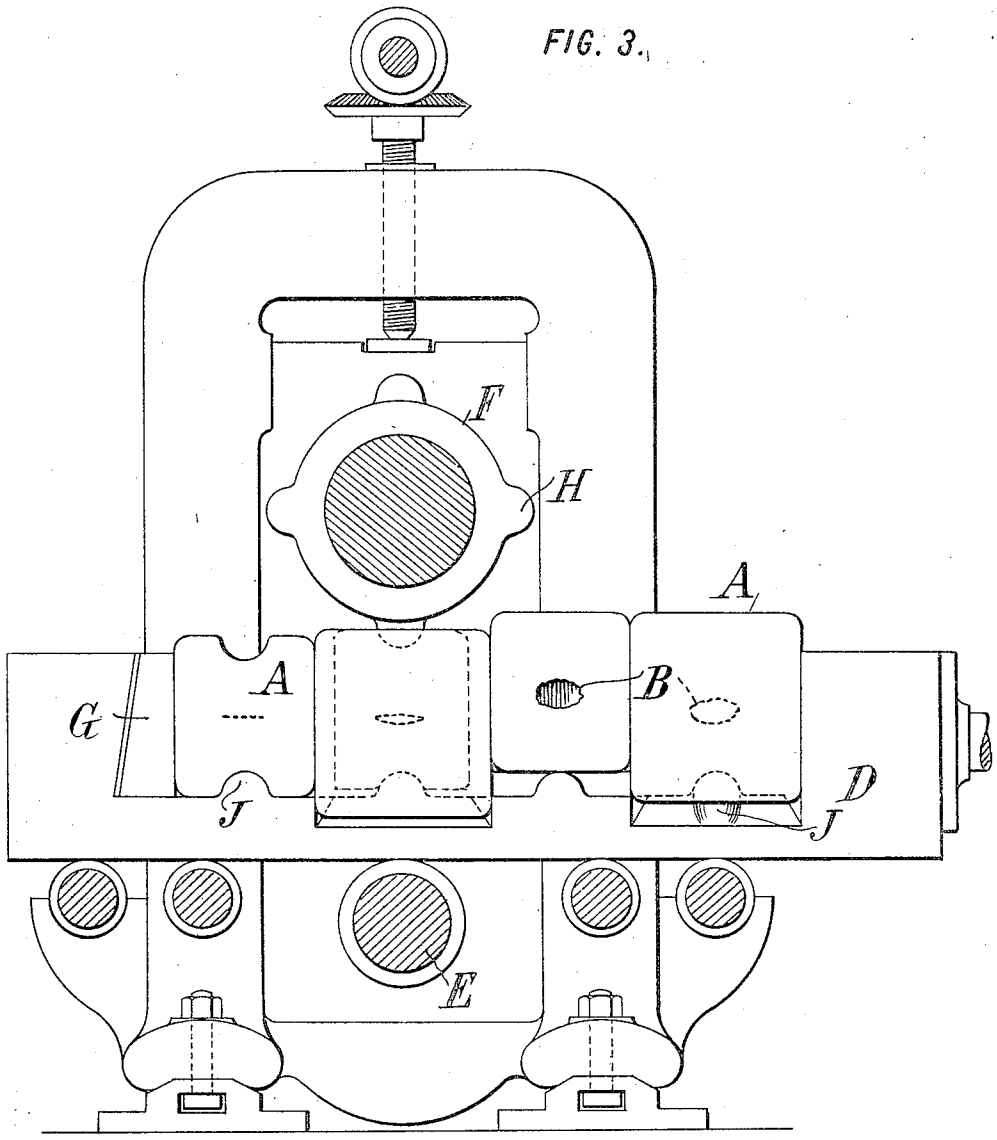
FIG. 3.



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3 SHEETS—SHEET 3.

FIG. 4.

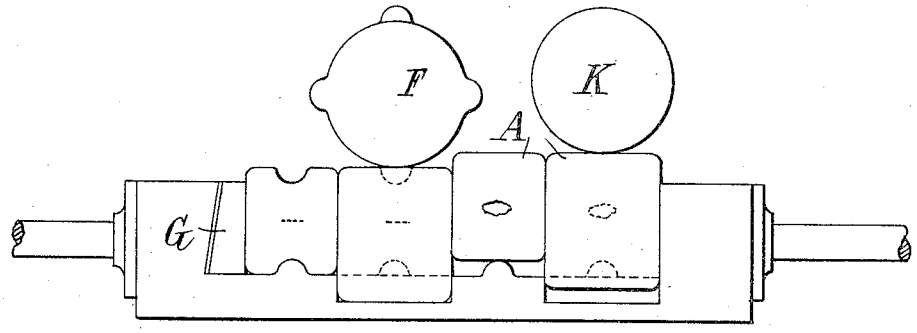
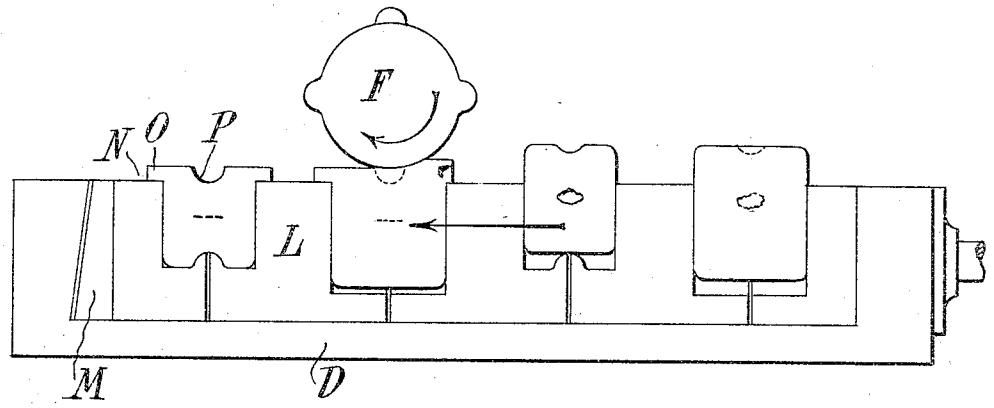


FIG. 5.



WITNESSES:

Fred White

René Bruine

INVENTOR:

James E. York,

By Attorneys,

Arthur G. Fraser & Sons

UNITED STATES PATENT OFFICE.

JAMES E. YORK, OF NEW YORK, N. Y.

SOLIDIFYING INGOTS.

1,035,933. Specification of Letters Patent. Patented Aug. 20, 1912.

Application filed October 25, 1907. Serial No. 399,123.

To all whom it may concern:

Be it known that I, JAMES E. YORK, a citizen of the United States, residing in the borough of Brooklyn, county of Kings, city and State of New York, have invented certain new and useful Improvements in Solidifying Ingots, of which the following is a specification.

This invention aims to provide a method and apparatus for making a solid ingot of cast steel or the like by closing the pipe which ordinarily forms at the upper end of the ingot. For this purpose I propose to roll the ingot laterally, at the same time pressing the metal from one or two sides of the ingot inward to cause the closing of the pipe and the welding of its walls together so as to make a substantially sound ingot. The pipes, as is well known, vary largely in length, and in fact a "bled" ingot may sometimes be cast, that is, with the pipe running through its entire length. The apparatus of this invention is adapted to eradicate the pipe whatever its length, the roll which is used for effecting the operation being preferably provided with projecting ribs of various lengths which may be substituted one for another. The rib on the roll, and preferably a corresponding rib on the bed at the under side of the ingot, are wide and long enough to cover any size of pipe, so that there is a merely local shifting of the metal of the ingot inward, leaving approximately semi-circular grooves at opposite sides of the ingot, the cubic contents of the two grooves being together equal to that of the pipe. Such an operation involves the use of comparatively little power, since there is no resistance to such shifting of the metal inward except the cohesion along lines parallel with the movement of the metal.

The process is preferably carried out as soon as possible after the casting of the ingot. In order to effect a perfect weld of the opposite surfaces of the pipe, thermit may be injected into the pipe. Ordinarily, however, a perfect weld may be effected without the use of thermit, and especially if the pipe is bridged or closed at the end, so that there are substantially no oxidizing gases within the pipe. Or in order to prevent the atmosphere from having access to the walls of the pipe, the end thereof may be stoppered with a plug of iron and sand as soon as the gases cease to escape from the pipe, such an operation being well known in mill practice.

The process may be made to serve also for the spreading of the metal laterally. By adopting a suitable shape for the ribs of the roll which force the walls of the pipe together, or by means of a supplemental rib the segregate which forms usually at the bottom of the pipe may be first squeezed out toward the end and the pipe then closed. The value of thus forcing up the segregate lies in shortening the part of the ingot which has to be cropped.

The process may also be modified to cover the closing of blow holes, especially when these form near the surface. It is blow holes near the surface which are injurious to the quality of the metal, and these are most easily rolled out of the metal by my process. For example the ingot may be first run under a plain roll to produce a comparatively shallow compression, but deep enough to eliminate dangerous blow holes; after which the bed may run under a second roll provided with ribs adjusted to shift the segregate and to close the pipe.

The apparatus may be designed so as to have a variable stroke, so that ingots may be carried under either one or both rolls at will.

The accompanying drawings illustrate more or less diagrammatically a machine for carrying out the invention.

Figure 1 is a plan of a roll with four ingots in position below it; Fig. 2 is a cross-section through a bed and lengthwise of the roll, showing an ingot between them; Fig. 3 is a longitudinal section through the bed of a mill. Figs. 4 and 5 are diagrammatic end views indicating other embodiments of the invention.

The ingots A are illustrated as of the ordinary type which in casting form pipes B of various depths, and in which the most impure metal is segregated at approximately the lower end of the pipe, as indicated at C. These ingots are laid upon a bed D which is given a reciprocating motion by means of a hydraulic ram or any other suitable mechanism, the bed being supported upon guide rollers E and passing under a working roll F. The base of the bed may be shaped to receive one or more (four in the present case) ingots A, which for compactness may be arranged with their small ends alternating at opposite sides. The base of

the bed, or a separate removable plate laid thereon, is provided with a surface so configured as to receive the ingots and present them to the working roll F with their upper surfaces substantially horizontal. An advantage of this is that the axes of the several ingots will be tilted upward somewhat, so that any liquid metal in the pipes will not flow out, consequently the ingots may be put upon the machine and subjected to the process before they are entirely solidified, and while they are so soft as to make the intended operations comparatively easy. The ingots may be clamped in the bed by means of a wedge G or any other suitable mechanism.

The roll is provided with a series of ribs H which may be removable so as to provide ribs of different lengths and of different contours in cross-section; or which may be fixed, different rolls being used for different classes of work. When the ribs are removable, it will be understood that they are formed of members which run the full length of the roll so as to permit the substitution of ribs of different lengths. Where the ingots are alternated in position as shown in Fig. 1, the ribs H will also be alternated. They will be made somewhat longer than the pipes to be rolled out, so that their ends will extend beyond the usual area of segregation. As the segregated metal is generally at the small end of the pipe, the ribs H may be made of substantially the same depth throughout their length, and this shape will result in the forcing of the segregation toward the upper end of the pipe at the first pressure of the rib upon the ingot and before the pipe closes, since this closing will not take place until the action of the roll on the ingot is substantially complete. Or they may be tapered, or a separate piece may be arranged between the roll and the work for this purpose; or a suitable projection may be arranged upon a plain roll which passes over the work before the ribbed roll.

The bed D is preferably provided with ribs J in line with the ribs H upon the roll. As these ribs H and J enter the ingot they press along a narrow line. The metal at the sides of the line is not materially confined, being free to yield upward (and sidewise in some arrangements), and consequently the resistance is much less than in cases in which it is proposed to press an entire side face of the ingot inward, or to press all the side faces together with no room for the metal to yield except into the pipe. In the present case a particular part of the ingot, that is to say the metal extending from the pipe outward in a single direction, is shifted to fill the pipe, while all the other metal of the ingot is free to yield. The rolling operation is an extremely rapid one; the process is not only advantageous but is very well adapted to the conditions found in practice.

The operation is not necessarily completed in one pass. A succession of rolls may be used, or the ingots may be passed backward and forward under the same roll more than once. The parts are so designed and synchronized that the roll necessarily stands in the same position for any given position of the bed. Consequently in any repetition of the rolling the rib will strike the ingot at the same point so as to accomplish its purpose most efficiently. The same result may be obtained by casting the ingot with ribs on two of its opposite outer walls corresponding in design to the ribs shown upon the roll; and running such an ingot through a plain roll or rolls. The metal protruding from the side of the ingot would then be pressed down toward the center until its outer face is flush with the outer face of the ingot, and a corresponding bulge would be formed inward in the pipe to close it. The closing of the pipe and also the raising of the segregate may also be effected by introducing a separate former between the ingot and the roll, instead of using a rib fastened on the roll, and the raising of the segregate and rolling out of the pipe may be effected in two separate operations instead of in one as above described.

The use of a pair of rolls, a plain roll K and a ribbed roll F, is indicated in Fig. 4. Each of these rolls may be vertically adjustable, as for example by the mechanism for adjusting the rolls of ordinary mills, so that the bed may receive its full stroke, and the work at the same time be brought into engagement with only one or with both rolls as desired.

The bed may be cooled by water circulation or the like, and may be arranged to take any shape of ingot, as for example an ingot which is square, flat round or polygonal in cross-section. In connection with the working out of the pipe, the process may be extended to the forming or spreading of the ingot to such a shape as to lessen the reduction necessary in the subsequent rolling of plates or I-beams, rails, channels, and similar flanged shapes. For this purpose the bed may be constructed as in Fig. 5, with sections L which are movable on the bed D, the adjacent faces being shaped to receive and clamp the ingots when the sections are wedged together by means of the wedge M, and the parts being so proportioned as to provide horizontal surfaces N at the sides of the ingots. Now when the roll F passes over the upwardly projecting ingots, it may roll the metal out laterally to form flanges O upon the surfaces N, as well as to press the center to form grooves P in line with the pipes.

The forcing of the metal inward may be accomplished at both sides of the ingot at once, as indicated in Fig. 3; or it may be first accomplished on the top face only and the ingot then inverted so that the groove made in the previous top face will fit at least approximately over the rib J on the bed; the metal being then rolled to form a second groove, which will be in the new top face.

As the ingots cool they contract and special precautions may be taken for maintaining them clamped on the bed; but ordinarily the work of the rolls will cause sufficient lateral expansion to compensate for the cooling contraction; or even to cause the ingots to fill the desired spaces tightly when they have been only loosely put in place.

What I claim is:—

1. The process of eliminating pipes from ingots, which consists in laying the ingot on its side with its upper face substantially horizontal, and running it under a roll bearing thereon with sufficient pressure to close the pipe.

2. The process of eliminating pipes from ingots, which consists in injecting thermit into the pipe and then pressing the walls of the pipe together to weld them.

3. The process which consists in passing an ingot first under a plain roll to eliminate blow holes near the surface, and then under a ribbed roll to force the material of the ingot into the pipe.

4. The process of eliminating pipes from ingots, which consists in arranging a number of ingots side by side and passing them in succession under a roll adapted to force the metal of the ingots into the pipe.

5. An apparatus for eliminating pipes from ingots, including means for supporting an ingot on its side with its upper face approximately horizontal, a roll bearing thereon with sufficient pressure to close the pipe, and means for running the ingot under said roll.

6. An apparatus for eliminating pipes from ingots, includng a bed adapted to support an ingot on its side with its upper face approximately horizontal, and having a rib in line with the pipe of the ingot.

7. An apparatus for eliminating pipes from ingots, including in combination a roll and a bed, said bed adapted to receive a number of ingots laid side by side with their small ends alternating in position.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES E. YORK.

Witnesses:
DOMINGO A. USINA,
THEODORE T. SNELL.