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G. V. SLOTTMAN
APPARATUS FOR INTRODUCING
OXYGEN INTO MOLTEN STEEL
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2,475,205

FIG. 1

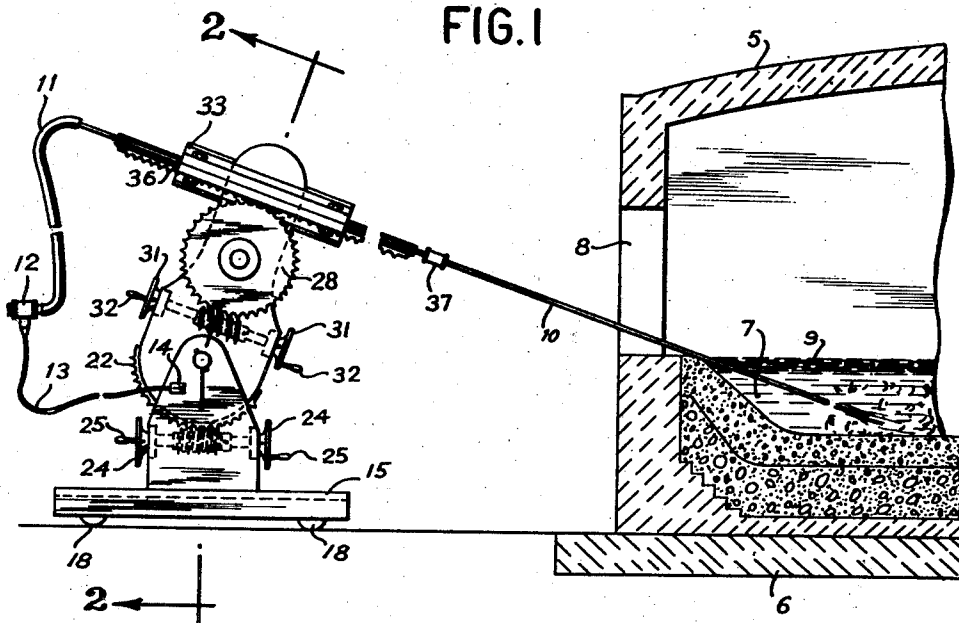
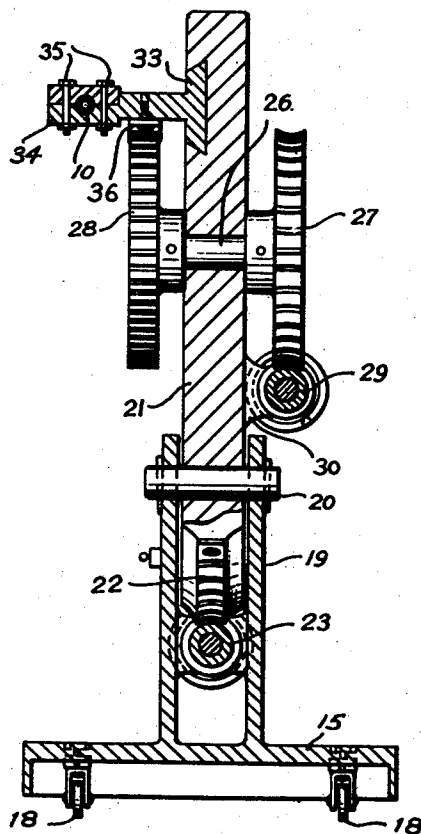


FIG. 2



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APPARATUS FOR INTRODUCING OXYGEN
INTO MOLTEN STEELGeorge V. Slottman, New York, N. Y., assignor to
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3 Claims. (Cl. 266—34)

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This invention relates to the manufacture of open hearth steel, and particularly to an apparatus adapted to facilitate the introduction of oxygen to molten steel in an open hearth furnace in order to reduce the carbon content of the steel near the end of the heat and before the metal is tapped.

Slottman, in an application Ser. No. 728,868, filed February 15, 1947, entitled "Manufacture of open hearth steel," have described a novel procedure for the reduction of the carbon content of the steel. In accordance with the procedure described in the application, after other impurities have been eliminated in accordance with usual open hearth practice, oxygen is introduced to the molten steel through a metal pipe, the end of which is introduced through the slag layer into the steel. Oxygen is introduced at a rate such that ignition of the metal pipe is avoided. Nevertheless, the end of the pipe is consumed by melting at a more or less constant rate, so that as the operation continues, the pipe must be fed forwardly and into the molten bath.

Thus, a 20-foot length of iron pipe will be about two-thirds consumed in from 8-12 minutes. During this interval, such a pipe having an internal diameter of 1 inch will pass about 3330 cubic feet of oxygen (at 70° F. and 1 atmosphere) at an apparent linear velocity of 1010 feet per second. When oxygen is introduced at this rate, the efficiency of the reaction with carbon is close to 100%, as long as the carbon content of the metal remains above 0.1%. Above this concentration of carbon, reaction takes place over the entire body of the metal, and carbon monoxide is given off in tiny bubbles bursting through the slag over its entire surface. Below 0.1%, the efficiency of oxygen usage in eliminating carbon falls off until, around 0.03% carbon, the efficiency is about 30% when using only one pipe. At this time, the greater portion of the area of the bath lies quietly, and the only evidence of carbon monoxide evolution is in a limited area where the pipe is working. The efficiency can be increased in this range (i. e., below 0.1%) if the number of pipes is increased so that the distance through which the oxygen must diffuse to meet the carbon is decreased.

It is essential that the end of the pipe be held within the molten metal below the slag level. It must not, however, approach too closely to the hearth, since the oxygen in that event will be consumed with possible damage to the hearth. The handling of a 20-foot pipe in the manner outlined requires two operators in order that

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the oxygen may be delivered with certainty to the molten metal without waste or destruction of the hearth. The operators are necessarily exposed to excessive heat, and the resulting fatigue. The operation is therefore relatively arduous.

It is the object of the present invention to provide a simple and effective apparatus which will facilitate the handling of the oxygen pipe, permit handling of the pipe by a single operator and materially reduce the labor involved with better assurance of the application of the oxygen in the most economical manner.

Other objects and advantages of the invention will be apparent as it is better understood by reference to the following specification and the accompanying drawing, in which

Fig. 1 illustrates the apparatus and its application in handling the pipe for introducing oxygen into the molten metal in an open hearth furnace; and

Fig. 2 is an enlarged detail in section showing the structure of the apparatus.

Referring to the drawing, 5 indicates an open hearth furnace having a hearth 6 carrying a layer of molten metal 7 and having a charging opening 8. A layer of slag 9 rests above the molten metal.

A pipe 10 is connected by a flexible hose 11 to a pressure regulating valve 12 through which oxygen may be supplied from any suitable source (not shown). The valve 12 is adapted to be operated through a flexible shaft 13 terminating in an operating handle 14.

In order to support the pipe 10, a platform 15 is supported on castors 18 and carries an upright bracket 19 with a journal 20 supported therein. A member 21, having its lower edge in the form of an arc carrying rack teeth 22, is mounted on the journal 20. The rack teeth engage a screw 23 mounted in the bracket 19 and having operating wheels 24 with handles 25 at opposite ends thereof. Thus, the member 21 may be tilted about the axis of the journal 20.

Rotatably supported in the member 21 is a shaft 26 carrying a worm gear 27 at one end and a gear 28 at the other. The worm gear 27 engages a screw 29 supported in legs 30 on the member 21 and having wheels 31 and handles 32 at opposite ends thereof. Thus the gears 27 and 28 may be rotated.

A member 33 is slidably supported in the member 21 and carries a clamp 34 for the pipe 10. Bolts 35 permit adjustment of the clamp to securely hold the pipe. A rack 36 is mounted on

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the member 33 and adapted to engage the gear 28, thereby permitting longitudinal adjustment of the member 33 in the direction of the axis of the pipe 10. A coupling 37 may be provided so that when the end of the pipe 10 is consumed, a new section may be attached readily.

In the operation of the device, the platform 15 is moved to the proper position in front of the charging opening 8 and the pipe 10 is inserted with its end beneath the surface of the molten metal. The member 21 may be tilted to present the pipe at the proper angle, and by rotating the worm 29 the pipe may be adjusted longitudinally to the proper position and may be fed to the furnace as it is consumed. When the pipe has been inserted in the proper position, the operator, by manipulating the handle 14, directs the flow of oxygen at the proper velocity into the molten metal.

The apparatus as described eliminates the necessity for a second operator and relieves the operator from all strain necessary in supporting the weight of the pipe. Thus the operator can give his attention to the application of the oxygen in the most efficient manner and can complete the treatment of the molten metal bath without substantial fatigue. If a pipe is consumed during the operation, it is necessary merely to attach a second pipe to the coupling 37, make the necessary adjustment of the apparatus and proceed with the treatment of the steel. The operator will, of course, manipulate the valve 12 to shut off the flow of oxygen during the replacement of the pipe.

Various changes may be made in the details of the apparatus as described without departing from the invention or sacrificing the advantages thereof.

I claim:

1. In a device for supplying gas to molten metal in a metallurgical furnace, a platform, an upright bracket on the platform, a journal in the bracket, a rocker having an arcuate lower edge pivoted

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on the journal, rack teeth on the arcuate edge, a screw mounted on the bracket and engaging the rack teeth, means for actuating the screw, a gas supply pipe clamp slidably mounted on the rocker and means for shifting the clamp axially on the rocker.

2. In a device for supplying gas to molten metal in a metallurgical furnace, a platform, an upright bracket on the platform, a journal in the bracket, a rocker having an arcuate lower edge pivoted on the journal, rack teeth on the arcuate edge, a screw mounted on the bracket and engaging the rack teeth, means for actuating the screw, a gas supply pipe clamp slidably mounted on the rocker and means for shifting the clamp axially on the rocker, including a rack secured to the pipe clamp, a gear engaging the rack, and means for operating the gear.

3. In a device for supplying gas to molten metal in metallurgical furnaces, a dirigible platform freely movable on a supporting surface, an upright bracket on the platform, a journal on the bracket, a rocker having an arcuate lower edge pivoted on the journal, rack teeth on the arcuate edge, a screw mounted in the bracket and engaging the rack teeth, means for actuating the screw, a gas supply pipe clamp slidably mounted on the rocker and means for shifting the clamp axially on the rocker.

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