United States Patent [19]

Taggart

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[54] **SCARFING**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **148/9.5**

[51] **Int. Cl.** **B23k 7/00,** B23k 7/04

[58] **Field of Search** 148/9.5

[56] **References Cited**

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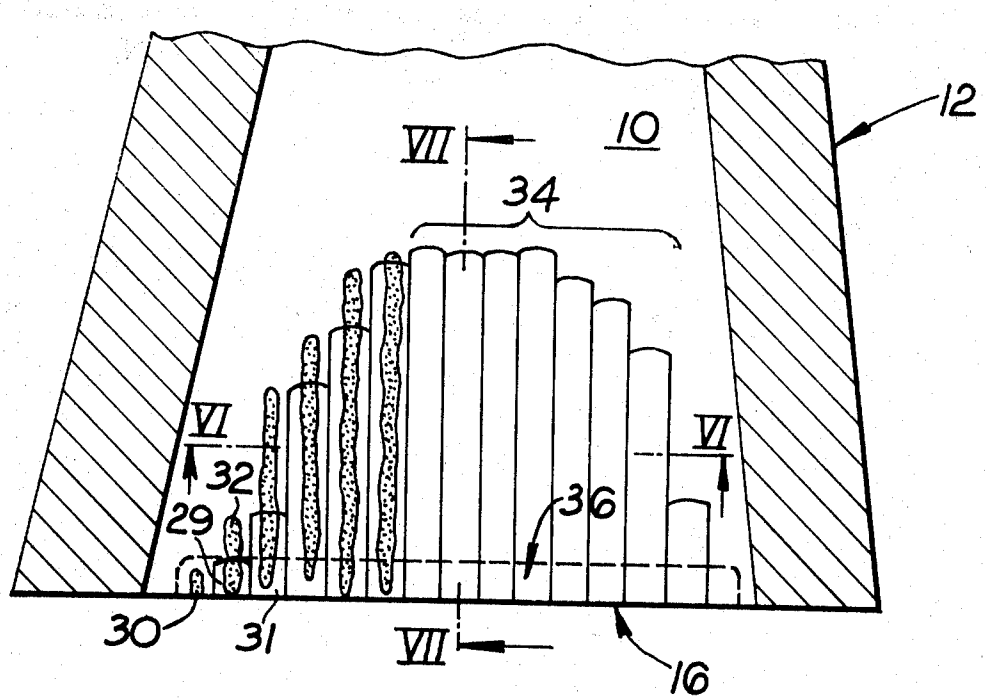
[57] **ABSTRACT**

In the scarfing of metal surfaces, such as the interior faces for ingot moulds, a flame torch is used to melt the surface and a jet of air or oxygen is directed separately onto the heated area to remove slag and impurities from the area being scarfed and from the path of the flame torch.

9 Claims, 7 Drawing Figures



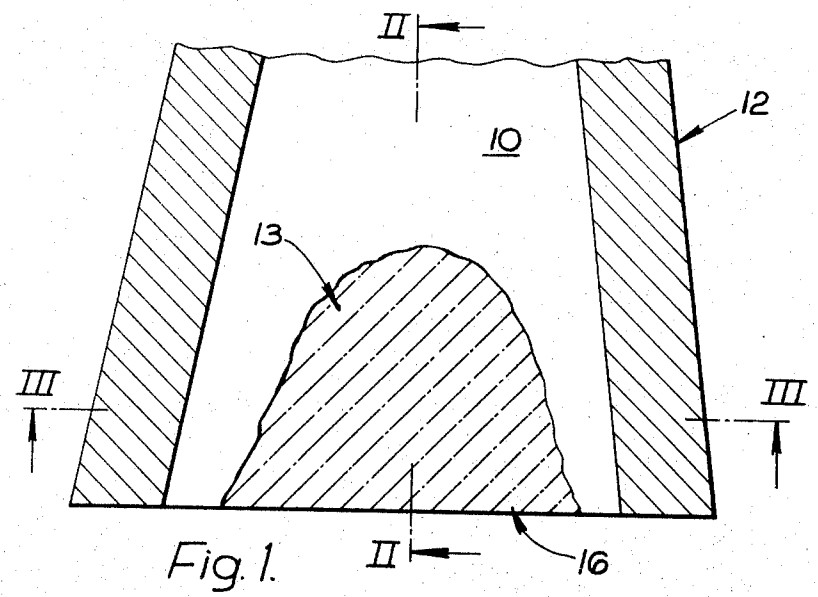


Fig. 1.

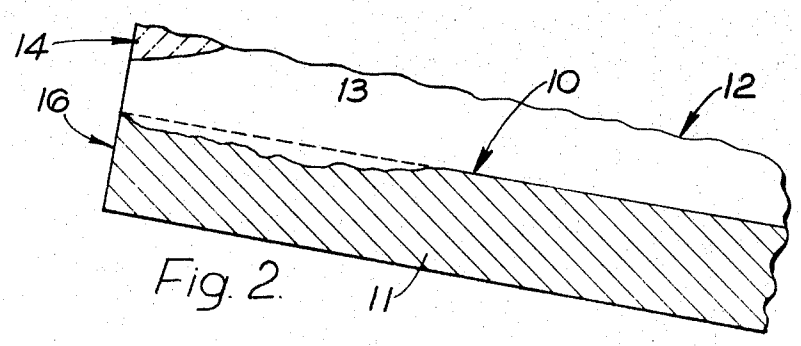


Fig. 2.

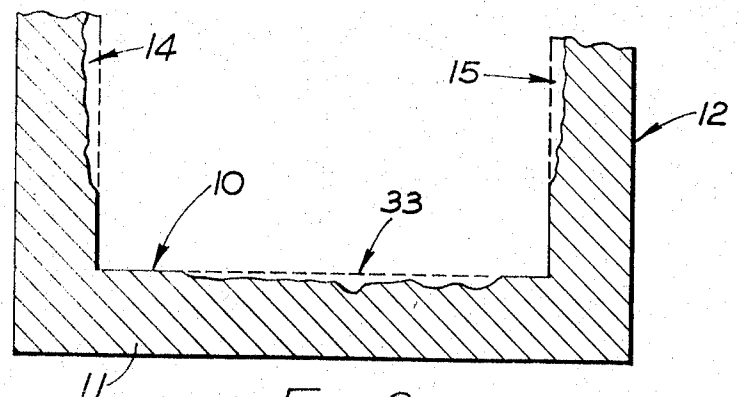


Fig. 3.

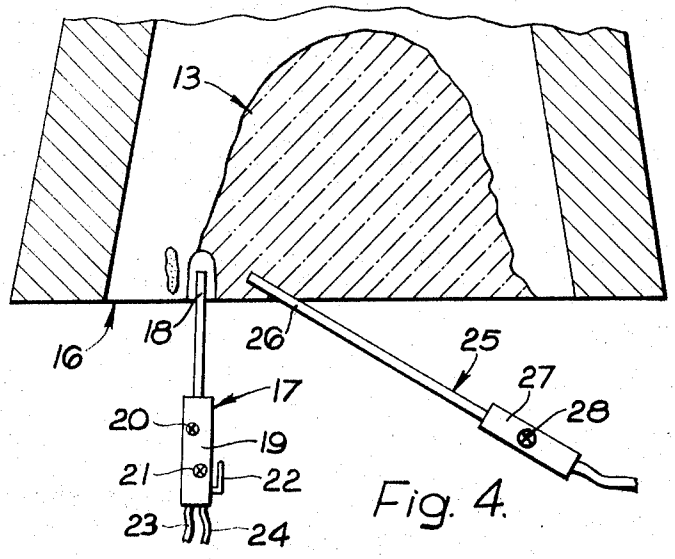


Fig. 4.

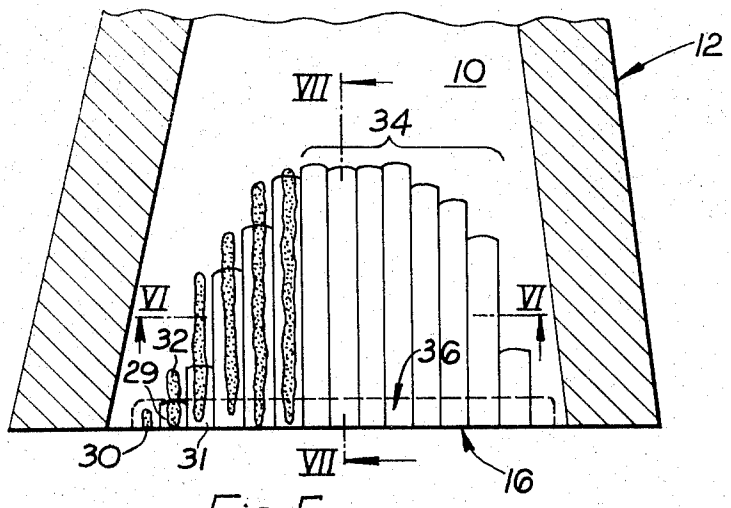


Fig. 5.

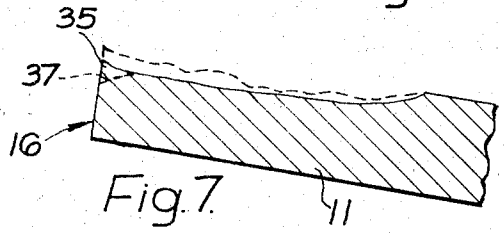


Fig. 7.

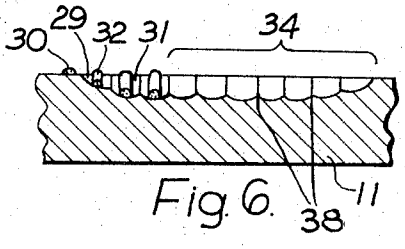


Fig. 6.

SCARFING

This invention relates to scarfing. When a steel ingot has been cast it can have a rather rough surface and usually has slag and the like on its surface. To smooth the surface it is usual to use a flaming or scarfing gun to melt the surface of the metal and impart thereto a better finish.

When an ingot mould, made usually from haematite iron, has been used several times its interior walls tend to become pitted and partly eroded by hot metal splashing thereonto during pouring. If the mould becomes very mis-shapen it becomes almost impossible to remove an ingot therefrom and to avoid this it is customary to scarfe or flame the inner walls of such moulds from time to time to smooth them and to restore their taper to ensure that a cast ingot can be removed therefrom.

Scarfing or flaming of a metal surface has, heretofore, not given a very good surface. Although a scarfed surface can be acceptable on an ingot before rolling it is not very acceptable on the interior of an ingot mould.

Heretofore metal surfaces have been scarfed using a flame gun having a nozzle from which its flame issues. Surfaces scarfed with such a gun tend to remain rough, black and covered with some slag and impurities, although their shape may be improved.

It is an object of the present invention to provide an improved method of scarfing or flaming a metal surface.

Accordingly the invention provides a method of scarfing a metal surface using a flame torch, characterised in that a jet of air or oxygen is directed towards that area of the metal being scarfed to remove slag and impurities from the surface of the metal and to move it from the path of the flame torch.

The jet of air or oxygen is preferably directed by means of an air nozzle disposed adjacent the usual nozzle of a flaming gun and directed at an angle thereto.

The air nozzle can be separate from the flaming gun or can be attached thereto.

Preferably the flame gun is moved, for example, by a first operative, along a series of adjacent parallel strips of the surface of the mould whilst the air or oxygen jet is directed, for example by a second operative, at the flame and area of the surface being melted by the flame gun, to move, from the surface of the molten metal created by the heat of the flame, any slag or impurities and transfer them to one side of the strip. It is advantageous if the slag and impurities are moved onto a surface which is either clean metal or has already been scarfed. This ensures that the area on the other side of the strip is not contaminated with slag or impurities and so can be easily scarfed later.

The invention will be described further, by way of example, with reference to the accompanying drawings, wherein:

FIG. 1 is a fragmentary cross-section through an ingot mould showing a lower area of one face thereof;

FIG. 2 is a cross-section taken on the line II—II of FIG. 1;

FIG. 3 is a cross-section taken on the line III—III of FIG. 1;

FIG. 4 is a view similar to that of FIG. 1 but illustrating scarfing taking place;

FIG. 5 is a view similar to that of FIG. 1 but after scarfing has been effected and after some slag and the like has been removed from the scarfed surface;

FIG. 6 is a cross-section taken on the line VI—VI of FIG. 5; and

FIG. 7 is a cross-section taken on the line VII—VII of FIG. 5.

A preferred embodiment of method conforming to the invention is concerned with ingot moulds. Ingot moulds are usually of hollow frusto-pyramidal form having walls about 10 to 14 inches thick and about 8 feet high and about 5 feet wide at their bases. They are usually made of haematite iron to resist the effects of molten steel thereon during pouring. After several ingots have been cast in a mould the inside walls thereof tend to become eroded and pitted. This damage can be extremely serious because if the walls become very damaged it may become impossible to remove a cast ingot therefrom because the steel of the ingot fills cavities eroded into the walls of the mould and forms a key.

To obviate this difficulty it is usual to flame or scarfe the inside walls of an ingot mould periodically to remove surface metal from the inside walls and restore a tapered surface to the mould.

FIG. 1 illustrates a lower area of an inside surface **10** of a wall **11** of an ingot mould **12.** A pitted and scarred area **13** is indicated by dot-dash cross-hatching. It will be appreciated that all four walls of the mould **12** will be so affected and comparable pitted and scarred areas are visible at **14** and **15** in FIGS. **2** and **3.** As can be seen in FIG. **2** the pitting is usually deepest at a position spaced away from the lower edge **16** of the mould **12,** that is at that position which receives most splashed material during initial pouring of molten steel. The steel hits a bottom plate (not shown), on which the mould **12** stands, and splashes back to hit the walls of the mould **12.** Higher up the mould **12** the metal already in the mould **12** reduces splashing and so the upper parts of the mould walls remain comparatively clean.

Before scarfing the mould **12** is laid down with one wall **11** thereof sloping downwardly away from its larger, open base. This will be apparent from FIGS. **2** and **7** and ensures that when the surface **10** is melted slag will flow away from the flame and not back onto previously scarfed areas.

Scarfing is effected by a first operative lighting a flame gun or torch **17** shown only schematically in FIG. **4** and which comprises a nozzle **18** some 25 mm in diameter, and a body **19** having controls **20, 21** and **22** and being connected to flexible propane and oxygen supply pipes **23, 24.** Controls **20** and **21** are valves which control the propane and oxygen supply and control **22** serves to by-pass the control **21** for a purpose to be later described. Once the torch **17** is lit the first operative directs the flame onto the surface **10** of the wall **11** at a point on one side, for example the left hand side, of the area **13** and heats up the surface **10** until melting of the metal thereof occurs. As this happens the first operative operates control **22** to cause valve **21** to be by-passed. The whole of the oxygen supply, at 120 pounds per square inch is then directed onto the metal whose surface is rapidly burnt away leaving clean

metal beneath the flame and an accumulation of slag, impurities and iron oxides in front of the flame.

A second operative holds an air tube **25** which is shown only schematically in FIG. **4** and which comprises a nozzle **26** and a body **27** having a control valve **28** and being connected to a flexible air supply pipe. When the first operative operates control **22** the second operative opens valve **28** and allows a blast of air at 120 pounds per square inch impinge upon the area of metal heated by the flame. This blast of air is directed at an angle to the direction of the gun **17** and the accumulation of slag, impurities and iron oxides is moved onto the clean metal adjacent the flame on the left hand side thereof. This leaves no slag on the unscarfed area of the surface **10** and allows the first operative to move the flame along the surface generally parallel to an adjacent side wall. The second operative moves the air tube also, adjusting the direction, and quantity, of the air supplied to effectively remove the slag, etc. By this movement a strip **29** of scarfed surface is created with a line of slag **30** on the left hand side thereof.

When the strip **29** reaches clean metal it is discontinued and a second strip **31** is scarfed in exactly the same manner, the slag from this strip forming a line **32** of slag on strip **29.** This process is repeated right across the affected area **13** until a plurality of scarfed strips is formed covering the entire area **13.** The slag can be quite easily removed from the strips, for example by chipping or scraping, and this has been shown done on the strips **34** on the right hand side of FIG. **5.** It will be appreciated that if any one area is particularly badly pitted, for example at **33** in FIG. **3,** then all areas between such position and the lower edge **16** of the mould **12** must be scarfed to below this level to obviate any possibility of a cast ingot becoming locked in the mould. This will be more easily appreciated from FIG. **7.** As can be best seen from FIG. **6** the junction between the strips are in the form of ridges **38** which do not affect removal of an ingot from the mould. If desired, however, they can be reduced or removed by scarfing therealong by the method described above.

FIG. **7,** along with FIG. **5,** also show a further step which may be necessary after the above described scarfing in strips. The portion of the face **10** adjacent the lower edge **16** is usually not deeply pitted or eroded and, further, it is not always possible to commence scarfing the strips right at the edge **16** because of the danger of the flame bouncing back towards the operatives. This may result in a lip **35** (FIG. **7**) being left along the lower edge. This can be removed by scarfing a further strip **36,** shown in dotted lines in FIG. **5,** to remove the lip **35** and leave a surface as indicated by the dotted line **37** in FIG. **7.**

The method described is, of course, effected on all four side walls of the mould. The surface obtained by the method of the invention is highly acceptable and greatly enhances the life of an ingot mould. The surface can, if the removal of slag is thoroughly effected, be shiny metal.

The invention is not limited to the precise details of the foregoing embodiment and variations can be made thereto. For example, oxygen can be supplied, via the "air tube" instead of compressed air, although this is less effective. A fairly good scarfing is still obtained, however. The method of the invention is not limited to scarfing of ingot moulds and can be applied to any metal surface, for example steel ingots can be scarfed before rolling. This is an extremely important application because any slag or impurities on an ingot which is to be rolled tend to become rolled into the metal and so become weak areas in the final product.

The flame nozzle need not be of the propane/oxygen type and any practicable fuel gas can be used. Many other variations are, of course, possible.

I claim:

1. A method of scarfing the inner wall surface of haematite iron ingot moulds using a flame torch, characterized in that a jet of air or oxygen is directed towards that area of the inner wall surface of the mould being scarfed to remove any slag and impurities from the surface and to move such slag and impurities from the path of the flame torch and wherein a first strip of the surface is scarfed, the slag and impurities being moved, by the jet, to one side of the strip, and a second strip is then scarfed on the other side of the strip, slag and impurities being moved from the second strip onto the first strip, the process being repeated until the whole surface has been scarfed.

2. A method as claimed in claim **1,** wherein any ridges left at junctions between adjacent strips are removed by further scarfing along the ridges.

3. A method as claimed in claim **1,** wherein the flame torch has three controls comprising, a valve for controlling the supply of compressed air or oxygen, a valve for controlling the supply of gas, and a by-pass control actuable to admit the full air or oxygen pressure to a nozzle of the torch, and inclusive of the following steps subsequent to the lighting of the torch; heating the inner wall surface of the mould by the flame until it starts to melt; operating the by-pass control to allow the full air or oxygen pressure to be supplied to the nozzle to commence burning of the inner wall surface; and switching on the jet of air or oxygen to remove the slag and/or impurities floating on the melted metal.

4. A method as claimed in claim **3,** wherein the jet of air is supplied by an air tube having a control for varying the flow of gas theredown.

5. A method as claimed in claim **4,** wherein the torch is operated by a first operative and the air tube is operated by a second operative.

6. A method as claimed in claim **1,** and applied to an inner lower surface of a wall of an ingot mould, and including the step of scarfing an additional strip along a lower edge portion of the wall transversely of the other strips, to remove any lip which may have been left.

7. A method as claimed in claim **1,** wherein the torch utilizes oxygen supplied at a pressure of over 100 pounds per square inch, preferably 120 pounds per square inch.

8. A method as claimed in claim **1,** wherein the air tube utilizes air supplied at over 100 pounds per square inch, preferably 120 pounds per square inch, through a tube at least 10 mm in diameter.

9. A method as claimed in claim **1,** further including the step of removing the slag left on the mould surface.

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