

- [54] **FORMATION OF STEEL STRIP**
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117/93.4, 93.43; 204/192, 312; 164/46, 48,
276, 277, 278, 281, 272; 425/223, 224

[56] **References Cited**

UNITED STATES PATENTS
510,808 12/1893 Lloyd 164/276 X

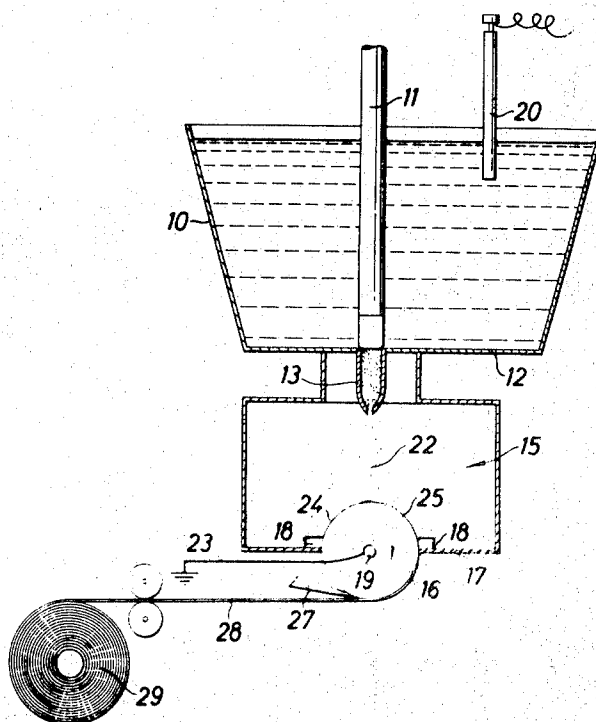
521,791	6/1894	Griscom.....	164/276
3,344,843	10/1967	Miller.....	164/46 X
2,639,490	5/1953	Brennan.....	164/278 X
2,864,137	12/1958	Brennan.....	164/46
305,716	9/1884	Schulze-Berge.....	164/277 X
2,491,889	12/1949	Bennett et al.	118/636 X

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[57] **ABSTRACT**

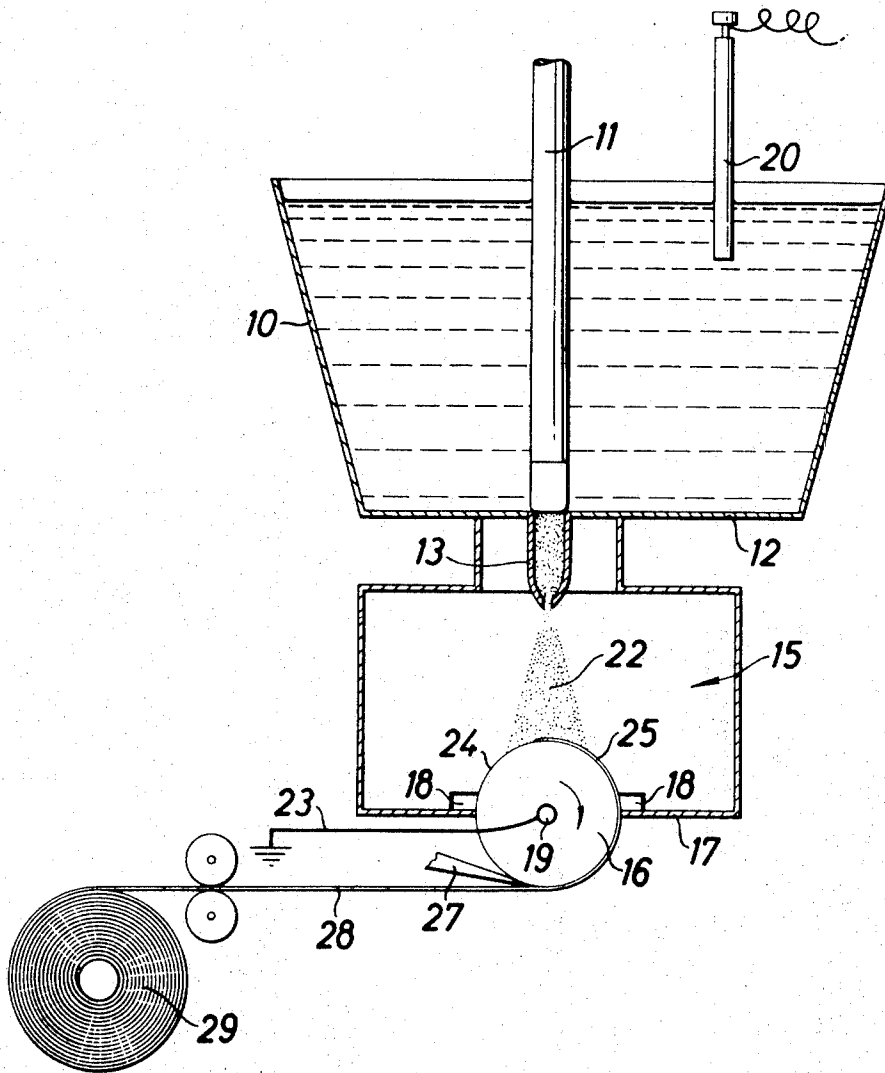
The present invention relates to a process for the continuous casting of metal strip, which process comprises imparting an electrostatic charge of at least 80,000 volts to a stream of molten metal, passing the stream of metal through a nozzle into an inert atmosphere and allowing the stream leaving the nozzle to atomise to a fine spray, collecting the spray droplets on a cool receiving surface to form a layer of metal on said surface and continuously stripping the layer of metal from said surface.

4 Claims, 1 Drawing Figure



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FORMATION OF STEEL STRIP

This application is a division of co-pending application Ser. No. 818,299, filed Apr. 22, 1969, now U.S. Pat. No. 3,576,207.

The present invention relates to the formation of steel strip.

At the present time steel strip is formed from ingots by slabbing and hot rolling. The present process is to some extent wasteful since in the formation of slabs from ingots, a certain amount of wastage results due to cropping of the ends of the ingot after it is rolled into a slab. These cropped ends have to be severed from the slab and are scrapped. There is also a large loss in yield due to scaling of the ingot and slab in the various stages of the known process.

According to the present invention there is provided a process for the continuous casting of metal strip, which process comprises imparting an electrostatic charge of at least 80,000 volts to a stream of molten metal, passing the stream of metal through a nozzle into an inert atmosphere and allowing the stream leaving the nozzle to atomise to a fine spray, collecting the spray droplets on a cool receiving surface to form a layer of metal on said surface and continuously stripping the layer of metal from said surface.

The receiving surface may be the cylindrical surface of a water-cooled roll and the receiving surface may be earthed. The inert atmosphere may be any gas which will not react with or dissolve to an appreciable extent in steel under the particular process conditions and which does not adversely affect the quality of the steel but is preferably argon, krypton or other inert gas.

The stream of molten steel may be tapped from a ladle or tundish which is insulated from its surroundings, the melt contained therein contacting with an electrode charged to a potential of at least 80,000 volts and preferably 100,000 to 200,000 volts to impart a charge to the contents of the tundish and to a stream of molten steel leaving the same.

The layer of steel stripped from the collecting surface may subsequently be rolled to form strip of the desired thickness.

Following is a description by way of example and with reference to the accompanying drawing of one method of carrying the invention into effect.

The accompanying drawing is a diagrammatic side view partially in section of apparatus for use in the process of the present invention.

A tundish 10 is provided with a discharge opening including a downwardly extending nozzle 13. A tapping rod 11 is vertically disposed with respect to the bottom 12 of the tundish 10 and extending therethrough to terminate at a lower end which is adapted to close the discharge opening. The tapping rod is provided with control means for controlling the flow of molten steel passing from the tundish 10 and through the nozzle 13. The nozzle end 13 of the tapping rod 11 is disposed within a collecting chamber 15 having an inert atmosphere of, for instance, argon which is maintained in the collecting chamber under a pressure slightly greater than atmospheric. Immediately below the nozzle 13 is disposed a rotatable water-cooled roll 16 which is disposed within the bottom surface 17 of the collecting chamber 15 glands 18 being provided to permit rotation of the roll 16 about its axis 19 with respect to the chamber 15 and without substantial loss of argon.

In operation, the tundish is periodically charged with molten steel and an electrode 20 is inserted in the molten steel and maintained at a potential of 100,000 volts. The tundish 10 and collecting chamber 15 are substantially insulated from their surroundings and the tapping rod 11 is operated to allow a continuous controlled stream of molten steel charged at a potential of 100,000 volts to pass down the tapping rod and out of the bottom end of the nozzle 13 into the collecting chamber 15. Free of the constraint provided by the walls of the conduit 21 in the tapping rod 11, the stream of molten steel debouching from the lower end of the nozzle 13 separates into a finely atomised spray 22 of steel droplets, the atomisation being caused by the electro-static charge on the stream which causes the stream to split into a number of small droplets each containing a lower electrostatic charge.

The roller 16 disposed below the nozzle 13 is earthed by means of conductor 23 and the droplets and the spray are attracted towards the surface 24 of the roll 16 and are deposited thereon to form a thin layer 25 of steel. The droplets coalesce on the cooled surface of the roll to form an uniform layer. The roll 16 is slowly rotated and is continually cooled by water passing through the inner structure of the roll.

The layer 25 of steel so formed is carried by the surface 24 of the roll 16 out of the collecting chamber 15 through the gland 18 between the wall 17 of the collecting chamber 15 and the surface 24 of the roll 16 and at a point externally of the collecting chamber, is stripped from the surface 24 of the roll 16 by suitable stripper means 27. The steel strip 28 so produced is then passed between one or more stands of rollers to a coiler 29 in the usual way. The strip obtained on the coil may be suitably reduced in a reduction mill to a desired thickness.

The sealing glands 18 between the roll 16 and wall 17 may comprise elongate conduits disposed adjacent the roller surface along which a nitrogen or mixture of nitrogen or argon is blown under pressure in an endeavour to prevent or restrict the escape of argon from the collecting chamber.

It will be appreciated that the process described above can effectively replace the stages of the present process for forming steel strip, from the ladle of steel obtained from the converter, through the ingot stage, soaking pit, slabbing furnaces, and coarse rolls on the hot reduction mill.

I claim:

1. Apparatus adapted for continuous casting of metal strip comprising a tundish having a vertically disposed tapping means terminating at its lower end in downwardly extending nozzle means, flow control means positioned adjacent the nozzle means and operable to control the flow of molten metal through said nozzle to the collecting chamber into which said nozzle debouches, rotatable collecting means provided below said nozzle in a surface of the chamber, and electrode means in electrically conductive relationship to the molten metal in the tundish whereby the molten metal is charged and passes from said tundish via said tapping means and nozzle, leaves the end of the nozzle in a downwardly directed spray and is collected on said collecting means.

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2. Apparatus as claimed in claim 1 wherein the collecting means is a rotatable water cooled roll disposed within the bottom wall of the collecting chamber, glands being provided to permit rotation of the roll about its axis with respect to the chamber wall and without substantial loss of gas from the collecting chamber.

3. Apparatus as claimed in claim 1 wherein the tundish and collecting chamber are substantially insulated from their surroundings and wherein motor means are provided for rotation of the roll about its axis so that

material collecting on said roll surface passes through said glands and out of the collecting chamber for subsequent stripping from the rolled surface.

4. Apparatus as claimed in claim 3 wherein the sealing glands between the roller and the walls of the collecting chamber comprise elongate conduits disposed adjacent the roller surface along which nitrogen or a mixture of nitrogen and argon is blown under pressure.

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