

Nov. 25, 1969

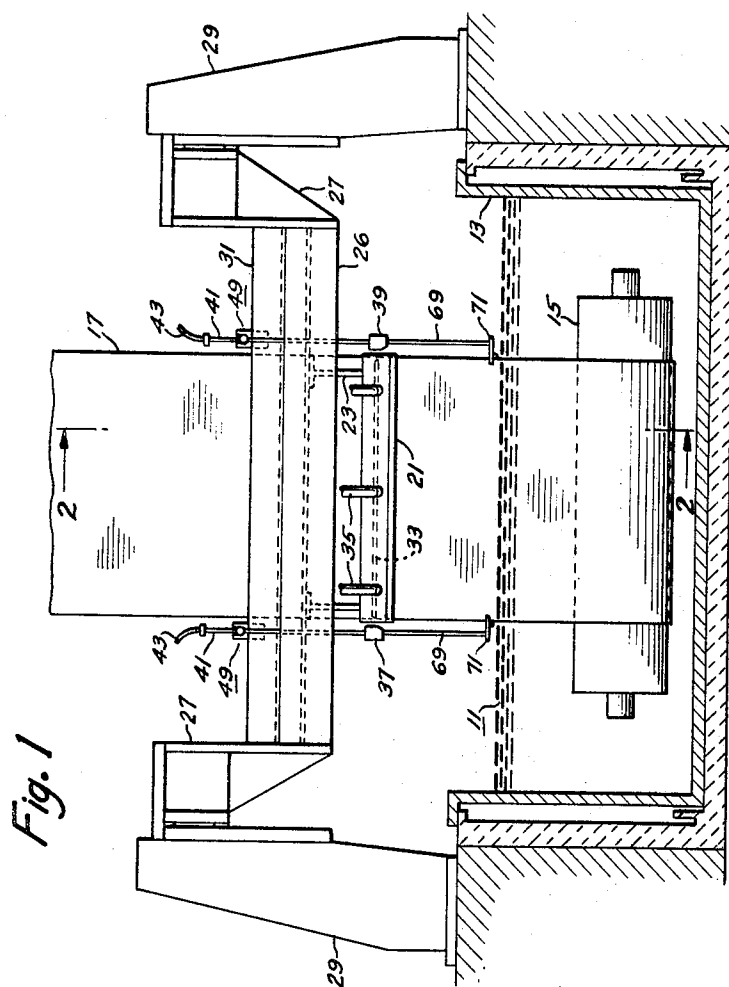
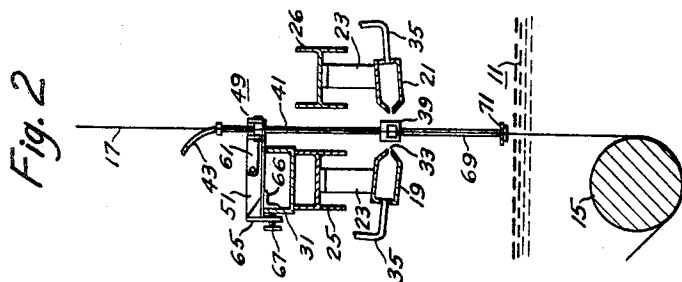
R. S. SHAFFER

3,480,469

AIR KNIFE AND VACUUM DOCTORING

Filed Jan. 19, 1967

2 Sheets-Sheet 1



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Robert S. Shaffer

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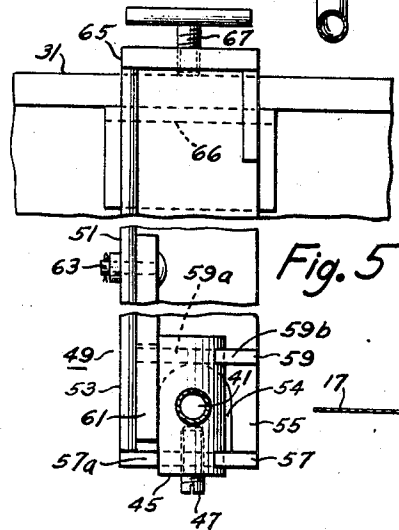
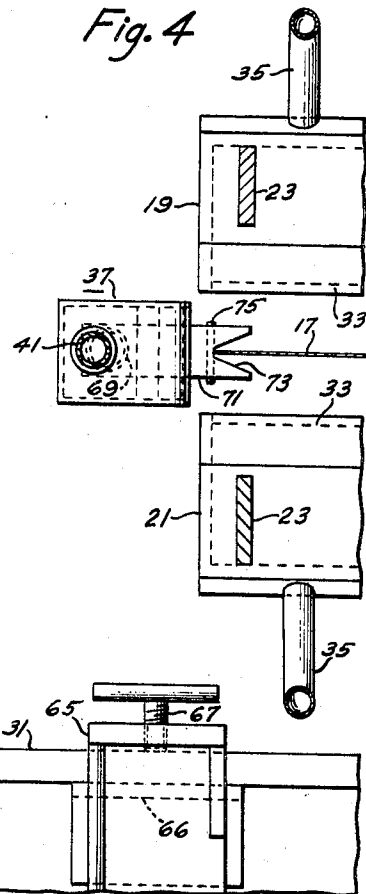
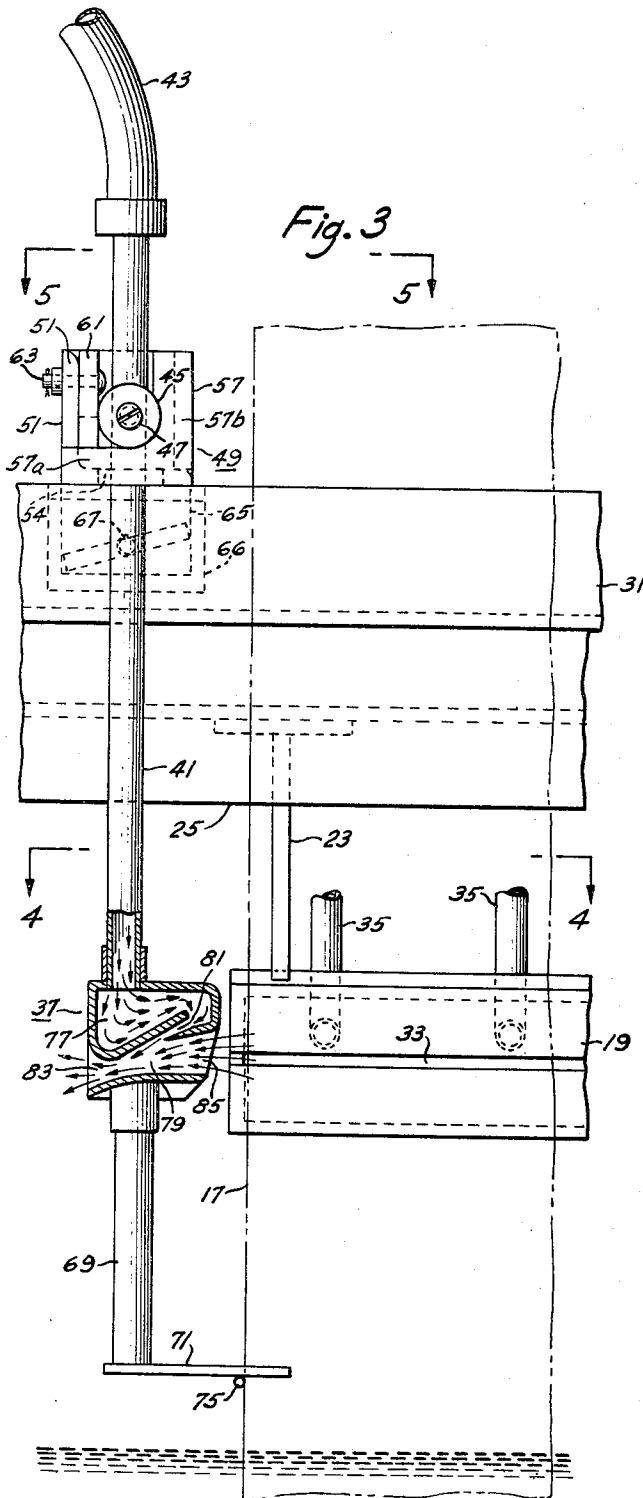
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AIR KNIFE AND VACUUM DOCTORING

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2 Sheets-Sheet 2



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3,480,469

AIR KNIFE AND VACUUM DOCTORING
Robert S. Shaffer, Glen Burnie, Md., assignor to Bethlehem Steel Corporation, a corporation of Delaware
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2 Claims

ABSTRACT OF THE DISCLOSURE

Aspirating devices are positioned adjacent the edges of sheet or strip passing from a molten coating bath between gas wiping dies to draw gas away from the edge of the sheet and thereby prevent edge buildup.

BACKGROUND OF THE INVENTION

This invention is directed to the treatment of moving sheet having a molten coating thereon to provide a uniform coating across the width of the strip.

Gas wiping arrangements for smoothing the molten coating on sheet leaving molten metal coating baths have been used to replace the more conventional exit roll arrangements in such baths. These so-called jet wiping arrangements provide a more even coating on the sheet and will operate efficiently on very fast moving sheet. As with the older exit rolls, however, difficulty has been experienced with so-called "edge buildup," a tendency to form heavier coatings near the edges of the sheet than are formed on the central portions of the sheet. The same expedients have been tried to eliminate this edge buildup with jet wiping devices as have been used to alleviate edge buildup with exit rolls, but without notable success.

SUMMARY OF THE INVENTION

I have discovered that edge buildup on sheet being coated in a molten metal bath and smoothed by means of a gas wiping arrangement can be reduced or eliminated by means of aspirators positioned adjacent the edges of the sheet which draw gases away from the edge of the strip. I hypothesize that such aspiration acts by reducing gas turbulence in the vicinity of the sheet edges.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a view of a molten metal coating bath apparatus incorporating the present invention.

FIGURE 2 is a sectional side view of a portion of the apparatus taken along line 2—2 of FIGURE 1.

FIGURE 3 is an enlargement of a portion of the apparatus shown in FIGURE 1 including a sectional view of the aspirating device of the present invention.

FIGURE 4 is a top view of the apparatus of FIGURE 3 viewed along line 4—4.

FIGURE 5 is a top view of a portion of the mounting arrangement of the apparatus viewed along line 5—5 of FIGURE 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings a molten metal bath 11 is held in a conventional pot 13. A sinker roll 15 is submerged in the molten bath 11 journaled in some suitable supporting means not shown. A metallic sheet or strip 17 to be coated with the metal of the bath is passed into the bath 11 around sinker roll 15 and out of the bath between gas wiping dies 19 and 21 mounted on supporting means 23 attached to I-beam supports 25 and 26 mounted above bath 11 upon side supporting structure 27 attached to side columns 29. A structural channel 31 is mounted upon I-beam support 25.

Gas wiping dies 19 and 21 are hollow and have narrow

slots 33 along their forward edges through which any suitable gas such as hot air, steam, or the like is forcibly expelled in a thin sheet extending across the width of the strip to wipe excess molten metal from the strip and smooth the molten coating remaining thereon. The gas is admitted to the dies 19 and 21 through three inlet pipes 35 connected to each wiping die. The slots 33 are aligned with each other on opposite sides of the strip 17 in order to prevent the strip from being forced to either side by the force of the gas blast.

Dies 19 and 21 normally extend a little beyond the edge of the strip 17 on each side in order to thoroughly wipe the strip across its entire face and also to allow for minor variations in the tracking of the strip.

Aspirating devices 37 and 39 are mounted adjacent each strip edge coplanar with wiping dies 19 and 21. Each aspirating device is supported on the lower end of a pipe 41 through which compressed air or other suitable gas or even liquid is fed from any suitable source, not shown, through flexible hose 43. Pipe 41 passes through a fulcrum member 45 in which it is secured at an appropriate level by a set screw 47. Fulcrum member 45 is mounted in a fulcrum assembly 49 comprising an angle 51 having a side 53 and a bottom 55 to which are secured two L-shaped fulcrum supports 57 and 59. Pipe 41 passes through an opening 54 in bottom 55 of angle 51 with sufficient clearance to allow transverse movement of the pipe. Fulcrum 45 rests on the bottom legs 57A and 59A of both fulcrum supports 57 and 59 and is urged into a partial circular cut-out section in the side legs 57B and 59B of the L-shaped fulcrum supports by a movable keeper bar 61 pivoted on a bolt 63 secured through side 53 of angle 51. The contacting surfaces between fulcrum 45, fulcrum supports 57 and 59, and keeper bar 61 may all be greased so that fulcrum 45 is free to pivot with the application of only a small force. Angle 51 of fulcrum assembly 49 is clamped in position transversely of channel 31 as shown in FIGURES 2, 3, and 5 by means of clamping plates 65 and 66, which fit over one flange of channel 31, and set screw 67 threaded through clamping plate 65 and biased against the flange.

Attached to the bottom of aspirators 37 and 39 is a tracking bar 69 to the end of which is attached a guide shoe 71 having a flat bottomed V-groove 73 in one end which fits over the edge of the sheet 17. A wear bar 75 of Stellite or other wear resistant material is secured to the bottom of guide shoe 71 at the bottom of V-groove 73 so that the sheet edge bears against the wear bar 75 as the strip passes upward through the V-groove 73 of the guide shoe 71.

Aspirator device 37 comprises two parts, an upper chamber 77 and a lower chamber 79. Pipe 41 opens into upper chamber 77 and compressed air passing down pipe 41 passes into chamber 77 which acts as a small plenum chamber to equalize small line surges and then passes uniformly through slot 81 into lower chamber 79 being directed forcibly toward the rear of chamber 79 and exiting through orifice 83 into the atmosphere. Chamber 79 is also open at the front and gas and air are drawn into this orifice 85 to replace the partial vacuum created by the aspirator action of the compressed air directed rearwardly by slot 81. Gas emerging from the gas wipers 19 and 21 adjacent the edge of the sheet together with more or less entrained air is consequently drawn into orifice 85 away from the vicinity of the sheet edge and expelled into the atmosphere to the side of the sheet. The continuous removal of such gas and air enables the wiping dies 19 and 21 to efficiently wipe the sheet all the way to the edge and thus effectively decreases or eliminates edge buildup.

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The gas and air which is expelled from orifice 83 thrusts aspirator devices 37 and 39 by reaction towards the sheet edge so that wear bar 75 is continuously held against the sheet edge and the entire aspirator device pivoting on fulcrum 45 follows or maintains the same correct distance from the sheet edge at all times regardless of tracking of the sheet or other variations.

While other designs of aspirator may also be successfully used, considerable experimentation has shown that it is very desirable to use an aspirator such as that shown, which has a relatively straight throat from orifice 85 to orifice 83, as the aspirator tends desirably to draw off protruding particles and beads of metal formed along the edge of the strip so as to form a very desirable rounded coating along the edge. These surplus molten metal particles are drawn through the aspirator and expelled with the gas and air and, if the throat of the aspirator is not relatively straight, will tend to form deposits on any sharp bends or corners in the device to such an extent as to eventually completely clog and block the aspirator.

My explanation for the results obtained by this invention is as follows: The collision of the gas streams from the two opposing dies 19 and 21 as well as the flow of the wiping gas around the edge of the strip creates turbulence at the edge of the strip which interferes with the wiping action of the gas jets near the edge of the strip. This interference is at a maximum near the edge of the strip and diminishes as the distance from the edge increases. In addition, there is a strong air current moving in toward the edge of the strip as a result of the partial vacuum created by the "Bernoulli effect" of the dies. This current of air produces additional interference with the wiping action of the gas dies. This turbulence and interference as a prime cause of edge buildup or heavy edge coatings on the strip. This turbulence and interference are greatly decreased if not completely eliminated by drawing the turbulent air and gas away from the edge of the strip by means of the aspirators above described.

The aspirators of the invention may also be used where the gas wiping dies are not coplanar with each other, or where a gas wiping die is used to wipe only one side of a flat product. In this case, even though there is no interference between the gas jets from opposed coplanar gas wiping dies, the edge of the product and the air stream moving in from the side due to the "Bernoulli effect" of

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the gas jets on one side may still cause excessive turbulence adjacent the edge. If so, the aspirators of the present invention may be used to alleviate this condition. It is essential only that the aspirators be located adjacent both the edge of the sheet and the impingement point of the gas jets on the edge of the sheet.

By the term "aspirator" as used herein I mean any apparatus, as a suction pump, exhaust fan, etc., for producing a movement of gases by suction.

I claim:

1. A method of coating sheet without edge buildup on said sheet comprising:

- (a) applying a molten coating material to at least one surface of the sheet,
- (b) passing the sheet with a deposit of still molten coating material on the surface past a gas wiping means adjacent the molten coated surface, and
- (c) drawing gases away from the edge of the sheet adjacent said gas wiping means by aspirating means located substantially in the plane of the sheet and spaced transversely therefrom.

2. A method of coating sheet according to claim 1 additionally comprising discharging the gas drawn from the edge in a direction away from the sheet in order to continuously bias the aspirating device toward the said edge of said sheet and maintain its correct position relative to said sheet.

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