Oct. 14, 1958 H. D. STERICK 2,855,644

INGOT MOLD MAT AND METHOD OF FORMING THE SAME

Filed Oct. 22, 1954

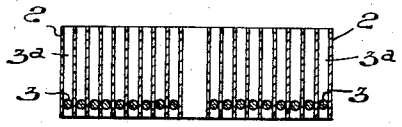


Fig. 1.

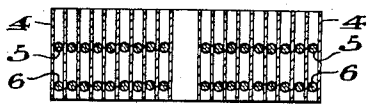


Fig. 2.



Fig. 4.



Fig. 5.

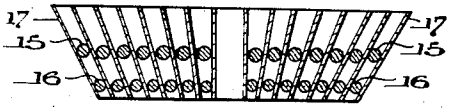


Fig. 3.

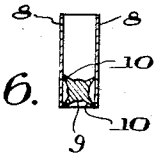


Fig. 6.

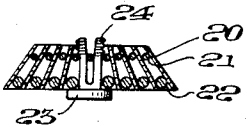


Fig. 7.

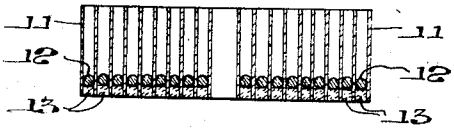


Fig. 8

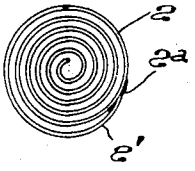


Fig. 9.

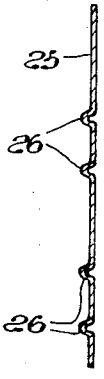


Fig. 10.

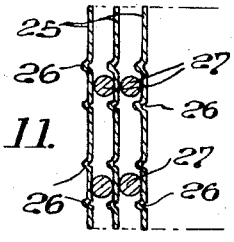


Fig. 11.

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INGOT MOLD MAT AND METHOD OF FORMING THE SAME

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7 Claims. (Cl. 22—139)

This invention is for an ingot mold insert mat and method of forming the same, and relates to mats formed from convolutions of strip metal with a separator holding the convolutions in spaced relation.

It is the practice in pouring steel in ingot molds to employ some kind of an insert or mat in the bottom of the mold to retard the washing of the molten steel over the bottom of the mold and the consequent erosion of the mold bottom and the undercutting of the side walls, and to reduce the formation of scabs on the exterior of the ingot due to hot metal splashing up onto and adhering to the interior walls of the ingot mold. Other economies also result from the use of these mats due to the fact that the end of the ingot formed by the bottom of the mold is usually cropped off and used for melting scrap. Since the mat becomes a part of the mold end which is normally cropped off, the space which it occupies does not need to be filled by molten metal, and hence less good metal is lost in the cropping of the ingot end.

One form of mat that has been successfully used is made from the coiling or winding of two strips of metal upon one another, one of these being smooth, and one being corrugated, with the smooth strip interposed between the convolutions of the corrugated strip. A mat so made is expensive because of the weight of the metal involved, while another drawback to such mats is that they do not present sufficient open area to result in a quick chilling of the metal at the bottom of the mold, or sufficient channeling to prevent washing of the metal.

A mat to provide optimum conditions for its use must first of all be practical and economical to make, and be economical in its material requirements, and unnecessary weight of metal must be avoided. A further condition is that the mat should be so formed as to provide over its surface grooves which are sufficiently open for metal to penetrate and be rapidly solidified and deep enough to retard splashing or washing of the metal. It should not be of such open character as to permit the free flow of metal through it onto the stool or mold bottom.

Among the several objects of my invention is the provision of a mat having a good surface; which is economical as to the weight of metal required; which may have deep channels or grooves in its face so as to retard splashing and washing of the metal, and a large extended heat-absorbing area so as to effect quick cooling of the metal.

A further object of the invention is to provide a mat which may be economically made, and which does not require any substantial departure in present manufacturing equipment.

A still further object is to provide a mat which may be formed with a taper or cone shape.

My invention may be more fully understood by reference to the accompanying drawings, in which:

Fig. 1 is a transverse vertical section through one form of mat illustrating my invention;

Fig. 2 is a similar view showing a slight modification;

Fig. 3 is a similar view of a modified mat formed in the shape of a truncated cone, i. e., having a larger top area than its bottom area;

Fig. 4 is a perspective view of one form of strip for use in making the mat shown on Fig. 3;

Fig. 5 is a perspective view of another form of strip for making such a mat;

Fig. 6 is a transverse fragmentary section showing two convolutions of a mat with a single modified form of separator;

Fig. 7 shows still a further modified form of tapered mat, in this case the mat being a truncated cone with the top area smaller than the bottom;

Fig. 8 is a view similar to Fig. 1 of a further modification;

Fig. 9 is a plan view of a mat embodying my invention;

Fig. 10 is a transverse section through another modified form of strip for practicing my invention; and

Fig. 11 is a transverse section on a smaller scale showing a fragment of a mat utilizing the strip of Fig. 10.

Referring first to Fig. 1 of the drawings, the mat is formed by coiling a wide strip of thin sheet metal, while simultaneously coiling between the convolutions of the sheet metal a spacer of wire-like form or section, the diameter of which is as great or greater than the thicknesses of the sheet metal, but the diameter of which is very small as compared to the overall width of the strip metal. In this view, **2** designates the convolutions of sheet metal, and **3** is the spacer. The spacer is here shown as comprising a round metal wire, the diameter of which is thicker than the thickness of the sheet metal, but the width of the strip is many times the diameter of the wire **3**. The wire **3** may be located close to the bottom of the mat, or may be located well above the bottom of the mat, the location shown in Fig. 1 being preferable. This results in the mat having convolutions which are well spaced from one another, with deep grooves or channels or crevices **3***a* between the convolutions. At the same time the bottoms of these crevices are substantially closed by the wires **3**.

When hot metal is poured onto the mat, the first metal will penetrate into the grooves and be solidified, and the initial washing or splashing of the metal will be eliminated. The hot metal is usually poured into the mold from the ladle located above the mold, and the mat will effectively break the fall of the molten iron and protect the bottom of the mold, and at the same time cause the metal to solidify rapidly.

An important advantage of this mat is that compared to its area it will be relatively light in comparison with mats now available. A mat, say fourteen inches in diameter, using for example a quarter-inch wire and thin gauge metal, will weigh very much less than a mat of corresponding size made by conventional methods of merely coiling the strip upon itself or coiling two strips, perhaps one plain and one corrugated, together.

After the mat has been formed by a coiling operation,

the outer convolutions can be tack welded together to prevent the mat from uncoiling as is now well understood in the art. This is shown in Fig. 9 where the spacer terminates short of the strip and the end of the outer convolution 2' is welded to the next convolution at 2a. This construction may apply to all of the forms shown, and is used so that the tightly wound coil may be shipped and handled without unwinding or coming apart.

In some cases, particularly where especially wide strip is used, it may be desirable for many reasons to use two spacers instead of one. This is illustrated in Fig. 2 where the convolutions of strip metal are designated 4, and 5 designates a spacing wire at one level, and 6 a spacing wire at a lower level. The wire 6 is close to the plane of the bottom of the metal, while the wire 5 is located well below the top. Such a mat is less likely to become damaged in handling, and it still provides a great advantage of lightness in proportion to its volume and area. The wires 5 are far enough from the top to assure the formation of deep channels or crevices between the convolutions of sheet metal.

Still further lightness may be secured by using a wire which is drawn with fins or grooves on the surface so as to have a relatively large overall diameter in proportion to the section of solid metal. This is illustrated in Fig. 6 where two convolutions of sheet metal are marked 8, and 9 is a wire having fins 10 formed in its surface, the view being somewhat disproportionate for the purpose of clarity of illustration. Between the outstanding fins on the surface of the wire there are of course grooves. There are sufficient ribs and grooves on the surface of the wire so that any way that the wire turns in the forming of the mat, the wire will still give a separation of the convolutions equal to, or substantially equal to, the overall diameter of the wire.

While I have shown in Figs. 1 and 2 the use of round wires, and in Fig. 6 have shown a specially formed grooved wire, these are merely illustrative, and twisted flat wire strips, square wires, or other special shapes are contemplated by my invention. Also while I have indicated that the wires may be made of metal, the spacers may also be made of cord, or rope, or paper pulp, or like fibrous or combustible material. In such case the grooves may be partly filled with graphite, or after the mat is formed, some mixture of refractory or refractory and graphite can be used in the bottom surface of the mat. This is indicated in Fig. 8 where the mat is formed of coiled strip metal 11 with a cord, such as tightly woven sash cord 12, acting as the spacer and below the cord the space between the convolutions is filled with a solidified mix 13 of fire clay and graphite or other plastic mass hardened in situ between the convolutions.

In any case the separator is of rod-like contour and section, having its mass substantially uniformly distributed about its axis so as to provide maximum spacing for a minimum weight of material. Also the spacer should be sufficiently firm so that the coil can be tightly formed and the spacer not be squeezed to a dimension where it is ineffective for its purpose.

Also by using strip metal which is corrugated as illustrated in Fig. 4, it is possible through the use of my invention to make a mat which is conical as illustrated for example in Fig. 3. In Fig. 3 I use two spacing elements 15 and 16, 15 being of larger diameter than 16, and I use a corrugated strip of sheet metal 17 as illustrated in Fig. 4. Because the spacer 15 is of larger diameter than 16, the convolutions will be spaced more widely at the top than at the bottom. The corrugated metal can be stretched during the coiling operation so as to compensate for the variation in length by reason of the convolutions which are shorter at the bottom and longer at the top. In lieu of using a corrugated strip of metal I may use an expansible strip as illustrated in Fig. 5 where the strip metal 18 is notched from the top and bottom edges inwardly with deep cuts or notches 19 which extend into the center line, but which are staggered on the two edges so as to allow one edge or the other to stretch.

In Fig. 7 I have shown a reversely-tapered mat in which the larger separators are at the bottom, and the smaller ones above them. In this view 20 designates the strip material which may be formed as shown in Figs. 4 or 5, 21 are the upper spacers, and 22 are the lower spacers. Also in this Figure I have shown a central core comprising a non-circular base 23 with a bifurcated post 24 into which the ends of the strip and the ends of the wires may be inserted. The non-circular end 23 of the post is received in a suitable chuck or socket on a winding disk, and the bifurcated post forms a core about which the metal is wound. This core is of an expendable character so that it may be retained in the mat as a part of the mat. Such a core of course may be used in the making of any of the other mats herein described.

Referring to Figs. 10 and 11, I have shown the strip 25 having beads rolled therein to provide channels to retain the wire or rod-like spacer or spacers. In these figures the strip 25 is shown as having two pairs of spaced beads 26 providing between each pair a trough to receive the wires or spacers 27. This facilitates assembly of the mat and makes it less likely for the spacers to slip out or out of place if the mats are thrown around or otherwise roughly handled. This construction is applicable to any of the forms of mats herein shown.

While the wide strips will preferably be of metal to give a rapid chilling effect to the molten metal, if this chilling effect is not desired they may be in whole or in part of other ribbon-like material, such as glass cloth, wire fabric, or impregnated fibrous materials.

While I have shown and described certain specific embodiments of my invention, it will be understood that this is by way of illustration and that various changes and modifications may be made within the contemplation of my invention and under the scope of the following claims.

I claim:

1. An ingot mold insert mat comprising a coiled ribbon of sheet metal having its convolutions separated by a separate continuous length of material of symmetrical rod-like contour constituting a separator which has an overall cross section at least as great as the thickness of the strip and the strip having a width several times the overall section of the separator, the top edges of the strip projecting above the top of the separator providing in the top surface of the mat a spiral channel to reduce the splashing of molten metal being poured onto the mat.

2. An ingot mold insert mat comprising a coiled ribbon of sheet metal having its convolutions separated by a separate detached continuous length of material of rod-like contour having an overall diameter greater than the thickness of the strip metal and the strip metal having a width several times the overall diameter of the separator, the separator being spaced downwardly from the upper edges of the strip whereby deep metal receiving spaces are formed between the convolutions and the bottoms of the spaces are closed against the passage of molten metal therethrough.

3. An ingot mold insert mat comprising a coiled ribbon of sheet metal having its convolutions separated by two spaced separators each separate from the other and from the ribbon, one above the other, of rod-like contour having an overall diameter at least as great as the thickness of the strip, and the strip having a width several times the overall diameter of either separator, the top edges of the strip projecting above the level of the top of the uppermost separator to provide in the top surface of the mat a spiral channel to reduce the splashing of molten metal being poured onto the mat.

4. An ingot mold insert mat as defined in claim 3 in which the strip is of a stretchable character and one of the spacers is of larger diameter than the other, whereby the mat tapers.

5. An ingot mold mat as defined in claim 4 wherein the strip metal is corrugated.

6. An ingot mold mat as defined in claim 4 wherein the strip metal is notched inwardly from each edge substantially to the center of the strip at close intervals, the notches on one edge being staggered with reference to those at the other.

7. The method of forming a conical mold insert mat which comprises winding an expansible sheet metal strip into a tight coil with a pair of separated spacing elements of rod-like contour between the convolutions with one spacing element having a larger overall section than the other, and stretching one edge of the strip as it is coiled to compensate for the increase in length caused by the differences in the sections of the spacers.

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