

[54] **MOLTEN METAL FILTER**

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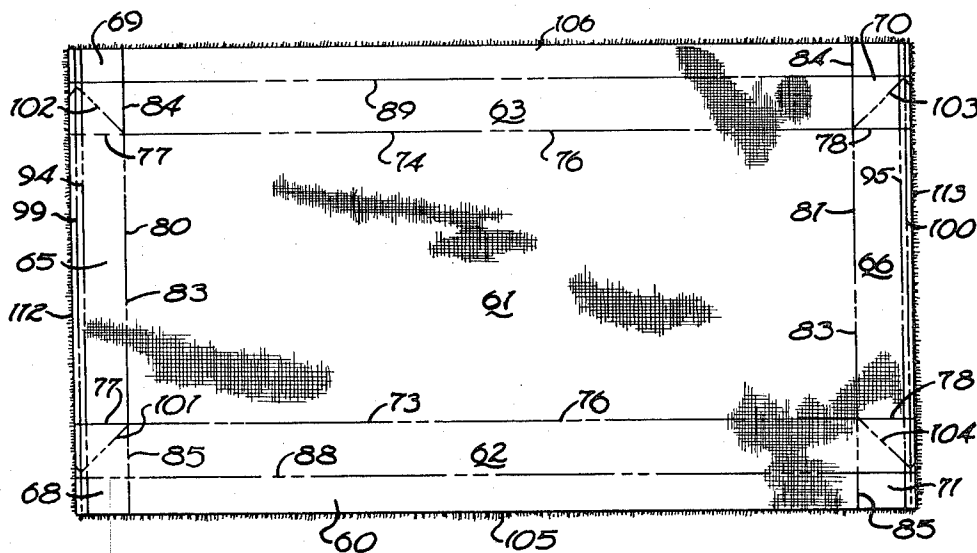
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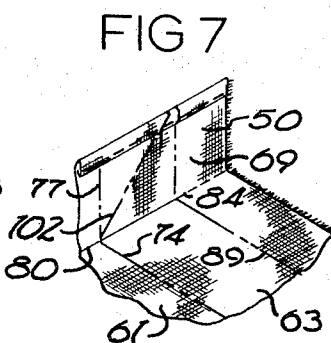
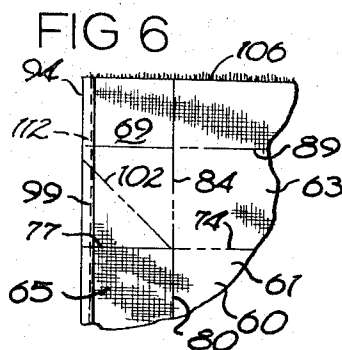
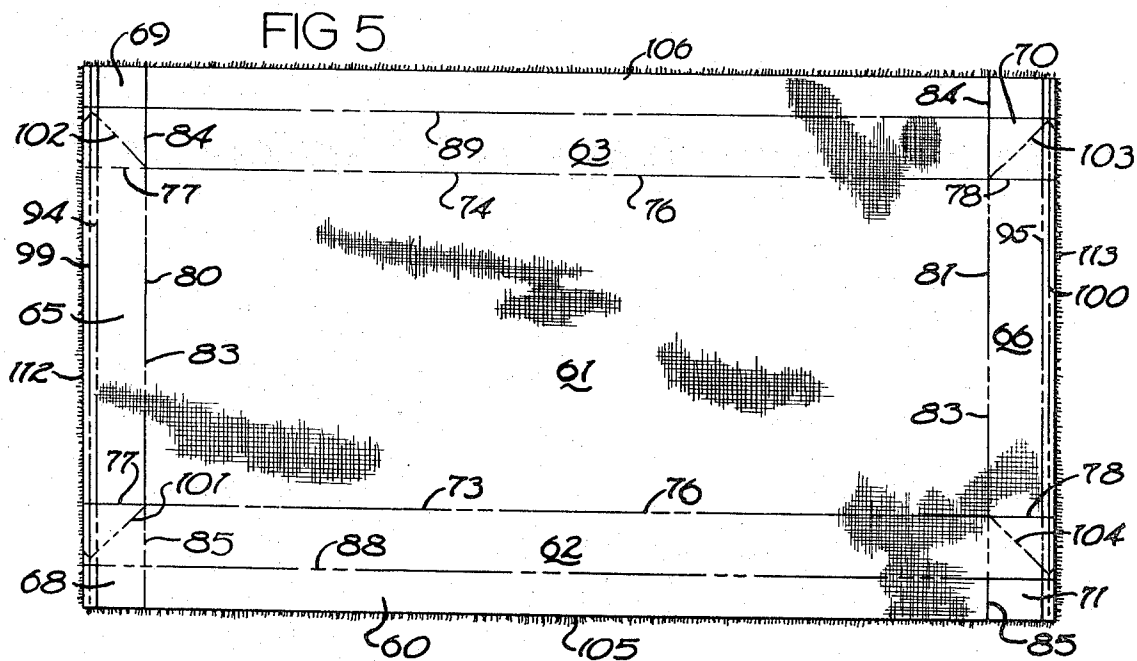
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ABSTRACT

A bag-shaped filter is described for removing solid contaminants from molten metal, particularly aluminum. The bag is constructed from a rectangular piece or sheet of woven glass fiber cloth. The bag is constructed with the edges of the cloth folded and secured to the inside of the bag.

2 Claims, 10 Drawing Figures





MOLTEN METAL FILTER

BACKGROUND OF THE INVENTION

This invention relates to the casting of metal ingots from molten metal and more particularly to filtering devices for filtering the molten metal as it is being cast to remove any solid particulate contaminate material therefrom.

It has been the practice, particularly in the aluminum industry, to utilize a woven fiber bag as a filter for filtering the molten metal as it is poured into a continuous casting mold to remove solid particulate material from the molten metal. Should any solid particles or foreign material pass into the ingot, it can ruin the entire ingot should the ingot be rolled into a thin sheet or foil. A hairlike foreign solid is destructive to a good number of feet of foil as the ingot is being rolled. Thus it is quite costly in the production of aluminum foil or thin sheet from ingot to have any foreign material or solid impurity in the ingot. A glass fiber cloth has been particularly effective in removing solid material from the molten metal before the ingot is formed. The fiber cloth will not melt or burn upon contacting the molten metal. The molten metal is poured into the filter bag with the metal flowing from the inside to the outside of the bag leaving the solid contaminate on the inside.

However, it has been found that in the manufacture of the fiber bag, it is difficult to construct the bag without having the edges of the cloth on the outside of the bag. Consequently, any loose or broken threads along the edge pass into the molten metal without being removed. Thus this filtering means itself can become a significant source of contamination.

One of the principal objects of this invention is to provide a filter for filtering the solid particulate material from the molten metal in the form of a glass fiber bag in which the edges of the bag are secured on the inside so that should any loose fibers or broken strands occur, they will be contained on the inside of the bag and will not contaminate the resulting ingot.

An additional object of this invention is to provide a very inexpensive means of forming all of the cloth edges of the bag on the inside so that any loose glass particles or broken strands, etc., will not contaminate the ingot.

These and other objects and advantages of this invention will become apparent upon the reading of the following detailed description of a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of this invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a vertical cross-sectional schematic view illustrating the continuous casting of an aluminum ingot with a filter embodying the principal features of the invention, shown removing solid particles from the molten metal;

FIG. 2 is a plan view of the filter and a supporting frame for supporting the filter in the path of the molten metal;

FIG. 3 is a fragmentary end view taken along line 3—3 in FIG. 2;

FIG. 4 is a fragmentary end view taken along line 4—4 in FIG. 2;

FIG. 5 is a preconstruction view of the filter showing the principal element of the filter being a rectangular piece or sheet of fiberglass cloth;

FIGS. 6—10 are sequence views showing the step-by-step construction of a corner of the filter.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring in detail to the drawings, there is illustrated in FIG. 1 a filter generally designated with the numeral 10 for removing solid contaminate or particulate material from molten metal 11 being cast into a solid ingot at a mold or form 12. The form 12 has side walls 13 forming a casting cavity 14. A water jacket 15 is formed surrounding the mold to cool the side walls 13 as the molten metal is poured into the cavity. Water 17 is ejected from the jackets 15 onto the side of the forming ingot to speed the solidification of the molten metal in the formation of the ingot. Cavity 14 has a bottom 20 that is mounted on an elevator 21 which progressively lowers as the ingot is formed in the continuous cast operation. Molten metal nozzle 22 extends downward into the cavity 14 pouring molten metal into the cavity 14. The opening of the nozzle 22 extends down below the molten surface 26.

Filter 10 is supported by a filter frame 28 that is mounted to the form 12 above the molten surface 26.

Filter frame 28 (FIGS. 2, 3 & 4) includes a rectangular rim 30 having sides 31 and ends 32. Support arms 34 extend outward from the sides 31 to engage the form 12. Shoulders 36 are formed on the support arms 34 to engage the edge of the form to center the filter frame 28 with respect to the cavity 14. The rectangular rim 30 has end notches 38 formed in the ends 32 adjacent the corners. The filter is supported by rods 40 that extend along the sides 31. The rods 40 have a foot end 41 and a lifting end 42 that extend through the notches 38.

The filter 20 comprises a rectangular shaped cloth bag 25 that is quite shallow with a large bottom wall 46 and relatively short side walls 47 and 48. The bag has end walls 50 and 51 that are connected to the side walls 47 and 48 at corners 53, 54, 55 and 56.

The cloth bag 45 is constructed from a rectangular piece of woven glass fiber cloth 60, illustrated in FIG. 5. The cloth 60 is divided for purpose of illustration into a large center section 61, narrow side sections 62 and 63, narrow end sections 65 and 66 and corner sections 68, 69, 70 and 71. First longitudinal fold lines 73 and 74 extending across the cloth 60 in the major dimensional direction. Each of the lines 73 and 74 has an intermediate segment 76 separating the center section 61 from the side section 62 or 63 and end segments 77 and 78 separating the end sections 65 or 66 from the corner sections 68, 69, 70 or 71. First transverse fold lines 80 and 81 extend across the cloth 60 in the minor dimensional direction. Each of the fold lines has an intermediate segment 83 separating the center section 61 from the end sections 65 or 66 and end segments 84 and 85 separating the side sections 62 or 63 from the corner sections 68, 69, 70 or 71.

Second longitudinal fold lines 88 and 89 extend across the cloth 60 parallel with and spaced to the outside of the first transverse fold lines 80 and 81 respectively. The distance between the first and second longitudinal fold lines defines the height of the side walls 47 and 48. Second transverse fold lines 94 and 95 extend across the cloth parallel with and outside the first transverse fold lines 80 and 81 respectively. The distance between the first transverse fold lines 80 and 81 and the

second transverse fold lines 94 and 95 defines the height of the end walls 50 and 51 respectively. In a preferred embodiment the distance between fold lines 73 and 74 and fold lines 88 and 89 is substantially greater than the distance between fold lines 80 and 81 and 94 and 95 so that the side walls 47 and 48 extend above the end walls 50 and 51. Third transverse fold lines 99 and 100 extend across the cloth parallel with and spaced to the outside of the fold lines 94 and 95 respectively.

Diagonal corner fold lines 101-104 extend from the intersection of first fold lines 73, 74 and 80, 81 outward to the second transverse fold lines 94 and 95 at an acute angle to the fold lines 73, 74 and 80, 81. In a preferred embodiment the diagonal lines are 45 degrees to the fold lines 73, 74 and 80, 81.

The cloth 60 has side edges 105 and 106 and end edges 112 and 113 defining the perimeter of the cloth. The cloth is usually cut from a strip woven to the proper width with woven selvage edges. The selvage edges are not always perfect and at least one has a fringe due to the method of manufacture. The cloth is sometimes cut from a bolt of fiberglass cloth with the side and end edges being frayed or raw. Thus it is desirable to secure the edges to the inside of the bag to prevent any broken or loose fibers from passing into the forming ingot.

The bag 45 is constructed by manipulating the cloth 60 in the following general sequence as illustrated in FIGS. 6-10: First, the end sections are twice fold 180° in one direction toward the center section 61 along the second and third transverse fold lines 94, 95, 99, and 100 with the end edges 112 and 113 being tucked under and hidden as shown in FIG. 6; Second, the folded back portions of the end sections 65, 66 are secured together to form a hem at each end of the cloth; Third, the end sections 62 and 63 and corner sections 68-71 are folded upward along the first transverse fold lines 80 and 81 respectively to an approximate 90° angle to the center section 61 to form the end walls 50 and 51 respectively as shown in FIG. 7; Fourth, the side sections 62 and 63 are folded upward along the first longitudinal fold lines 73 and 74 respectively to an approximate 90° angle to the center section 61 to form the side walls 47 and 48 respectively; Fifth, simultaneously with the fourth step, the corner sections 68-71 are folded upward along the diagonal fold lines 101-104 with the line segments 77, 78, 84 and 85 directed upward substantially parallel with each other (See FIG. 8); Sixth, the corner sections 68-71 are folded back upon the side walls 47 and 48 along fold line segments 77, 78, 84 and 85 with the corner sections engaging the back surfaces of the side walls; Seventh, the side sections 62 and 63 are folded back upon themselves to the inside of the bag along the second longitudinal fold lines 88 and 89 with the corner sections 68-71 folding over the side sections 62, 63 terminating on the inside below the top of the end walls 50, 51; and Eight, the folded over portion of the side sections are secured to the side walls along the side edges 105 and 106 spaced from the fold lines 88 and 89 forming side channels 124 and 125 that extend the full length of the side walls terminating in openings 127 above the end walls 50, 51.

The folded back portions of the end and side sections may be secured to their respective walls by a variety of fastening means. Preferably, the folded back portions

are secured by sewing a fiberglass thread through the layers to form end seams 120 and side seams 122. It should be noted that all of the edges are either tucked under (encapsulated) or are on the inside of the bag.

The filter 10 is mounted on the frame 28 by first inserting the rods 40 through the channels 124, 125 and then positioning the rods in the notches 38 (FIGS. 2-4). The frame and filter is then placed in the cavity 14 as shown with the bottom wall 46 submerged below the liquid surface 26. The nozzle is inserted into the bag. Should any broken or loose edge fibers become displaced from the bag they will remain on the inside of the bag and not contaminate the ingot being poured.

It should be understood that the above described embodiment is merely illustrative of the principles of this invention, and that numerous other embodiments may be readily devised by persons skilled in the art without deviating therefrom. Therefore only the following claims are intended to define the invention.

What is claimed is:

1. A filter for removing solid particulate material from molten metal, comprising:
 - an integrally formed cloth bag having pervious bottom wall, side walls and end walls constructed from a woven rectangularly-shaped glass fiber cloth said cloth having;
 - a rectangular central section for forming the bottom wall;
 - two side sections on opposite sides of the central section terminating in side edges for forming the side walls;
 - two end sections on opposite ends of the central section terminating in end edges for forming the end walls;
 - four corner sections at corners of the cloth for interconnecting the end and side sections to enclose the bag;
 - said cloth having first longitudinal fold lines extending longitudinally across the cloth separating the central section and the side sections and separating the end sections and corner sections;
 - said cloth having first transverse fold line extending transversely across the cloth intersecting the first side fold line separating the central section and the end section and separating the side sections and corner sections;
 - said cloth having second longitudinal fold line extending longitudinally across the cloth intermediate the first longitudinal fold lines and the side edges;
 - said cloth having second transverse fold lines extending transversely across the cloth intermediate the first transverse fold line and the end edges intersecting the second longitudinal fold lines;
 - said cloth having third transverse fold lines extending transversely across the cloth intermediate the second transverse fold lines and the end edges;
 - said cloth having a diagonal fold line extending diagonally from the intersection of the first fold lines to the second transverse fold lines;
 - said side and end walls being constructed in sequence with (1) the end sections and corner sections between the second transverse fold lines and the end edges being twice folded in one direction back upon themselves along the second and third transverse fold lines with the end edges tucked under and hidden, (2) the end sections and corner

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sections being folded in the one direction along the first transverse line to a substantially right angle to the central section to form the end walls; (3) the side sections and corner section being folded in the one direction along the first longitudinal fold lines and the diagonal fold lines to a substantially right angle to the central section to form the side walls; (4) the corner sections being folded back along the outside of the side walls along the first transverse fold lines from the intersection of the first fold lines to the side edges; (5) the side sections and corner sections being folded back upon themselves to the inside of the side wall along the second longitudinal fold lines; and

securing means for securing those portions of the side, corner and end section that have been folded

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back upon themselves to the side and end walls respectively to secure the edges on the inside of the bag.

2. The filter as defined in claim 1 wherein the distance between the first longitudinal fold line and the second longitudinal fold line is greater than the distance between the first transverse fold line and the second transverse fold line so that the side walls extend above the end walls and wherein the folded back portions of the side sections and the end sections are secured to the side walls spaced from the second longitudinal fold line to provide channels extending the length of the side walls and opening at the corners above the end walls to receive support rods therethrough.

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