Sept. 6, 1938. E. B. HUDSON 2,128,941

DIRECT CASTING OF SHEETLIKE METAL STRUCTURES

Filed April 1, 1936 4 Sheets-Sheet 1

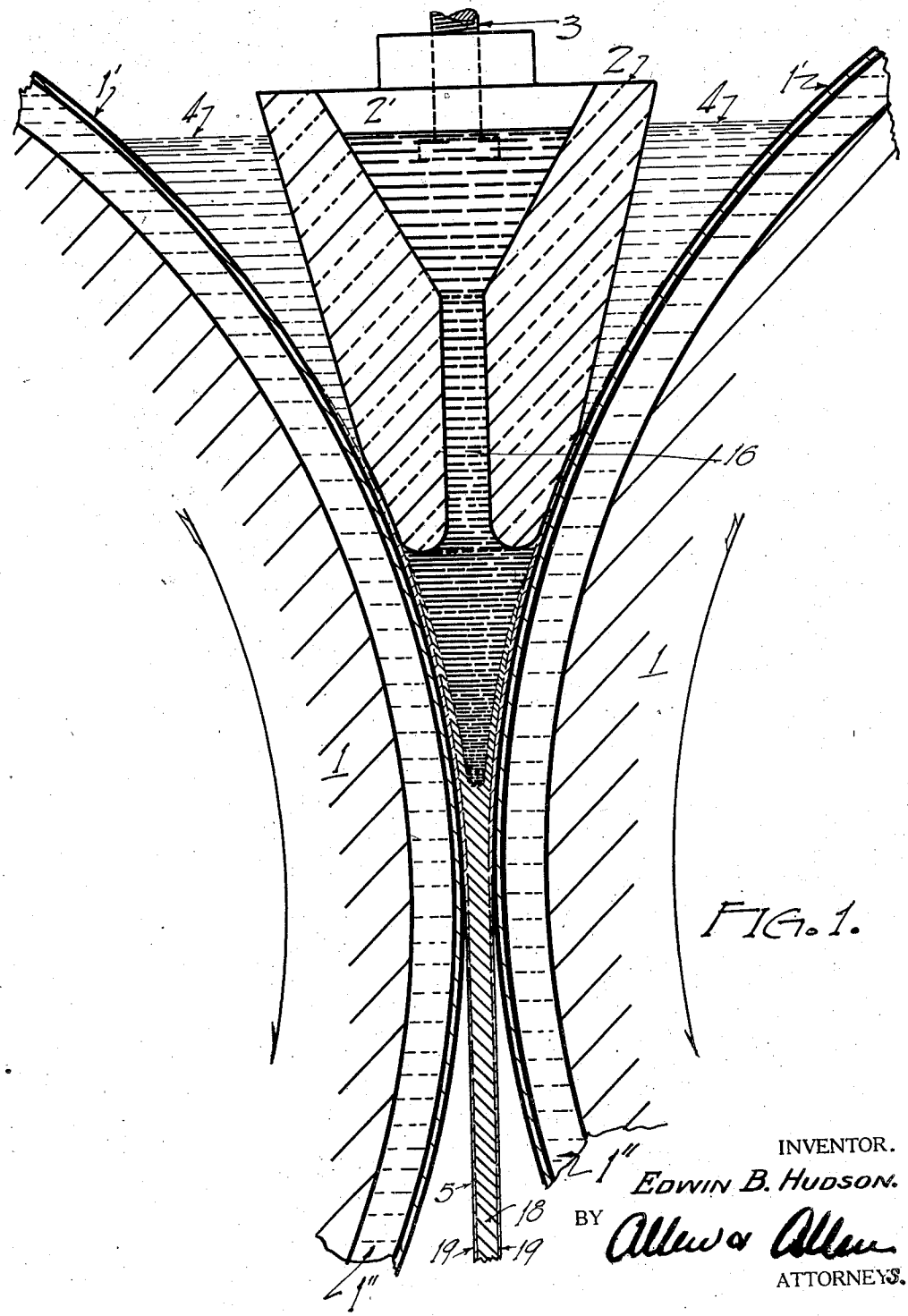


FIG. 1.

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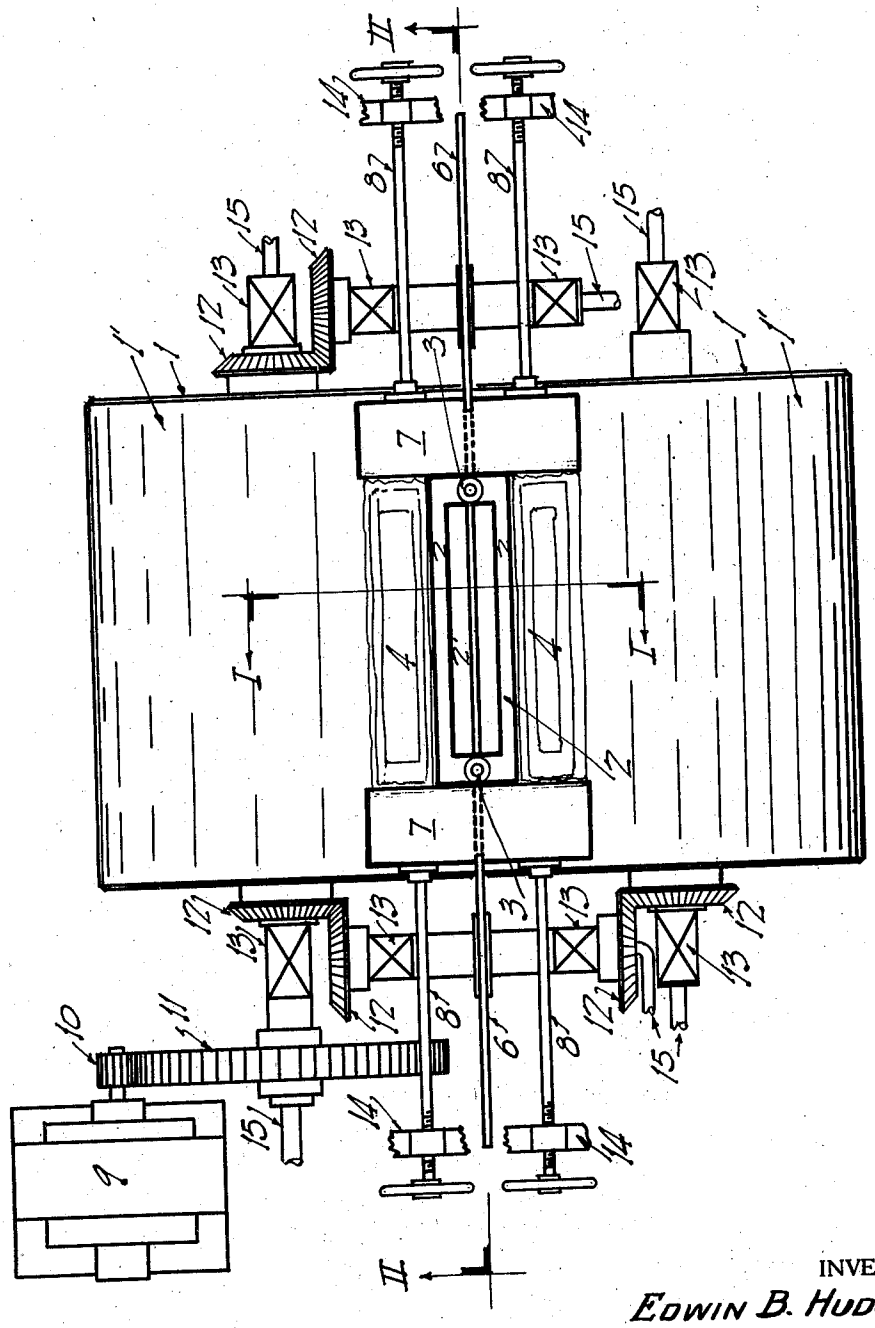


FIG. 2.

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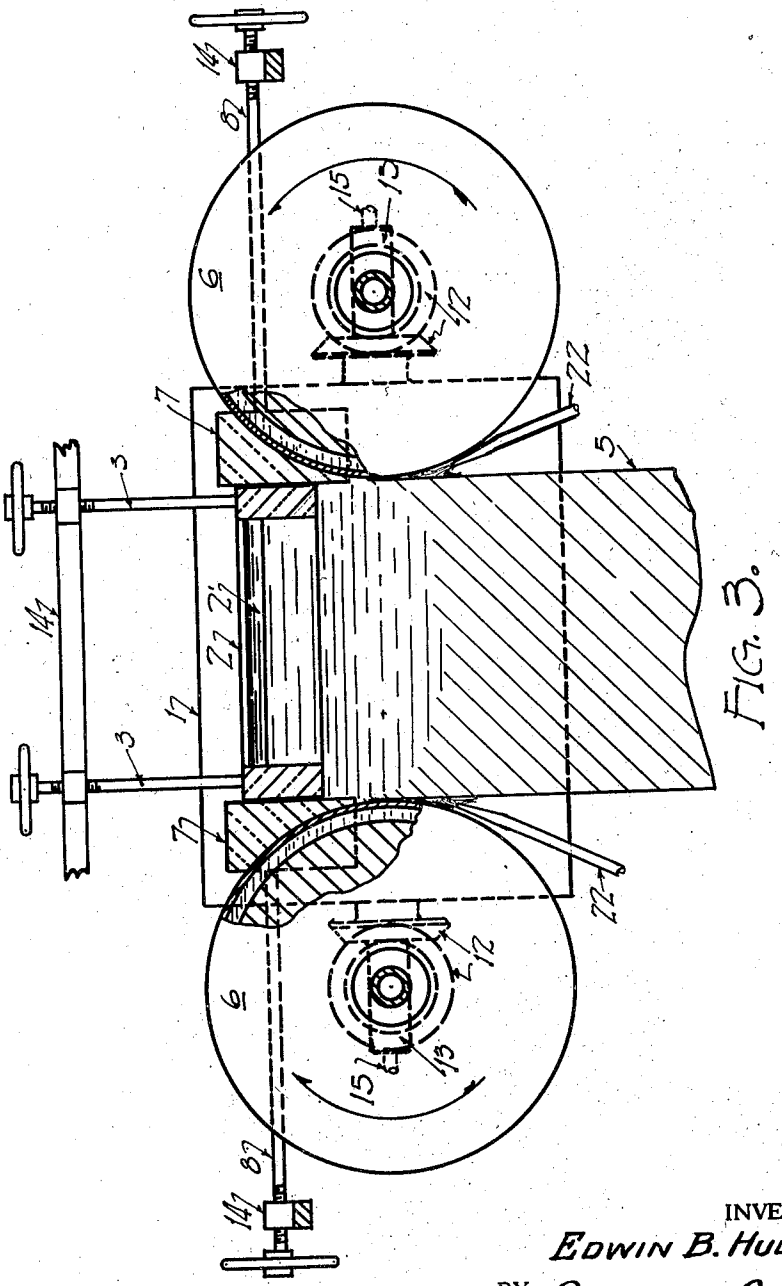


FIG. 3.

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DIRECT CASTING OF SHEETLIKE METAL STRUCTURES

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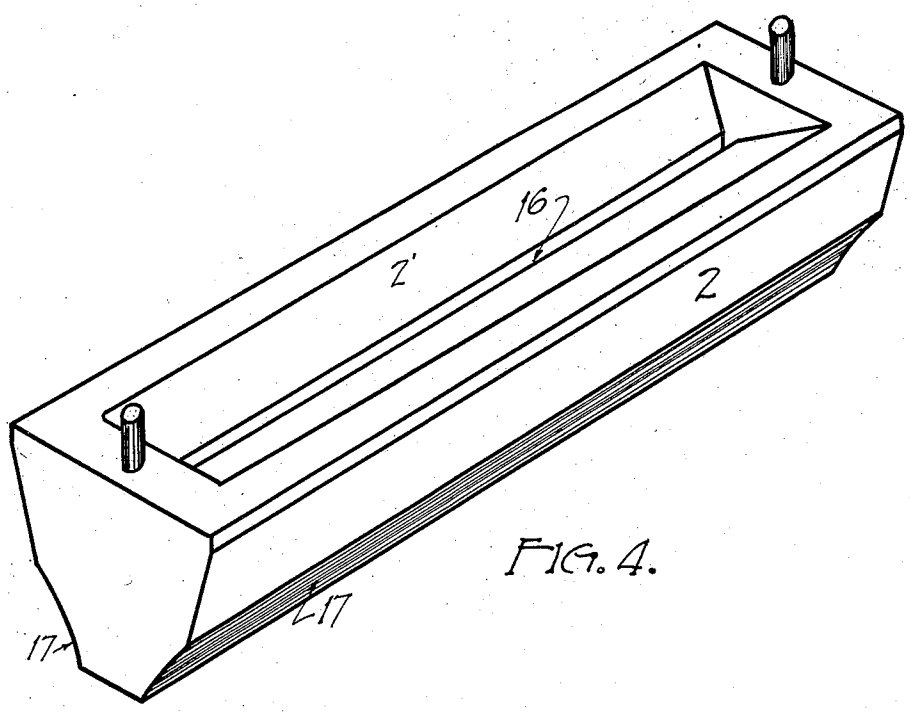


FIG. 4.

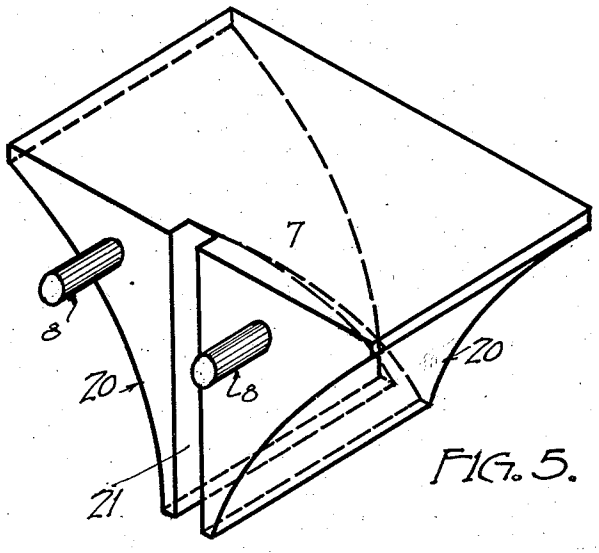


FIG. 5.

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Patented Sept. 6, 1938 2,128,941

UNITED STATES PATENT OFFICE

2,128,941

DIRECT CASTING OF SHEETLIKE METAL STRUCTURES

Edwin B. Hudson, Middletown, Ohio, assignor to The American Rolling Mill Company, Middletown, Ohio, a corporation of Ohio

Application April 1, 1936, Serial No. 72,126

8 Claims. (Cl. 22—57.5)

My invention relates to the direct casting of sheetlike metal structures or shapes either useful as such, or suitable for reduction as by rolling or for fabrication. It is an object of my invention to carry on the casting operation in such a way as to provide an exterior skin of metal on both sides at least of the piece being formed, the solidification of the body of the structure proceeding after the formation of the skin, and to this end it is an object of my invention to cast a composite structure from metal from two sources. Although my invention contemplates the direct casting of bi-metal structures, it has particular advantage in casting pieces made of a single metal, which pieces are of heavier gauge than is now practicable. The advantages of my invention in this aspect lie in the pre-solidification of an envelope for the piece before the envelope comes into contact with the larger quantity of center metal. For this reason I do not desire my claims to be restricted to a bi-metal structure excepting where expressly stated. I shall describe my invention, however, in connection with the making of a bi-metal structure as an exemplary embodiment and for the purpose of pointing out the additional advantages thereof in this particular aspect. In this aspect it is an object of my invention to provide a process of direct casting and a cast structure in which a protective covering, such for example, as stainless steel, copper, or the like covers a center core of the body metal such for example, as iron or mild steel, such a metal strip possessing all the advantages of the more expensive metal at greatly reduced cost. It will be understood, of course, that the metals given herein are exemplary only of metals to which my invention may be addressed. It is my object to provide a process in which the thickness of the protective metal can be adjusted, as desired, in its relation to the base or body metal, and also a procedure in which the thickness of the cast article may be gauged and regulated.

The ancillary objects of my invention which will be set forth hereinafter or will be apparent to those skilled in the art upon reading these specifications, I accomplish by that certain construction and arrangement of parts, in that process, and in that article of which I shall now describe the aforesaid exemplary embodiment. Reference may now be made to the drawings in which:—

Figure 1 is a partial sectional view of the casting rolls along the line I—I of Fig. 2.

Fig. 2 is a top plan view of the strip casting machine.

Fig. 3 is a sectional view taken along the lines II—II of Fig. 2.

Fig. 4 is an isometric view of the refractory member employed for gauging the thickness of the envelope and for retaining and feeding the supply of body metal.

Fig. 5 is an isometric view of one of the corner blocks employed in my device.

Briefly, in the practice of my invention, I provide a casting device including two main casting rolls so mounted, preferably, that the distance between their peripheries may be varied, and so arranged generally that a supply of molten metal held in the bite of the rolls will be solidified and fed through the bite in sheet form. I also provide edging rolls to define the thickness of the sheet so formed and to assist in the solidification of the edges. I provide means for isolating a quantity of molten metal which may be of the same or of different characteristics, as I have indicated hereinabove, and for feeding this metal down into the envelope formed by the solidification of metal against the first mentioned rolls. The isolating means is also used in connection with the first mentioned rolls for gauging the thickness of the envelope.

To attain my objectives I have provided as shown in the several figures, a pair of main cooling rolls 1—1. As shown most clearly in Fig. 1 these rolls are so constructed as to provide a shell 1', preferably made of a metal of high conductivity, such for example, as copper and spaced away from the body of the roll 1 by any suitable means, so as to provide a space 1'' for a suitable gaseous or liquid cooling medium. I also preferably provide edging rolls 6 which are thin and which pass between the main cooling rolls 1—1. The edging rolls may preferably have the same construction to provide for cooling; and means for the ingress and egress of cooling media to the several rolls may be made in any way desired, but is preferably made by providing inlet and outlet ports and suitable connections thereto through the shafts on which these rolls are mounted. The rolls 6 and 1 may be driven by a motor 9 through suitable speed controlling transmission members such as the pinion 10, the gear 11, and the mitre gears 12 as shown particularly in Fig. 2. The rolls are mounted in suitable journals 13 in a frame partially shown at 14. The cooling medium may be supplied and exhausted through the pipes 15.

In order to segregate either portions of the same metal or different molten metals during the casting process I have provided a member 2 of

a form most clearly indicated in Fig. 4, but shown in cross section clearly also in Fig. 1. This member is preferably made of refractory material and is suspended by adjusting means such as screws 3. This member has a hollow interior space indicated generally at 2' and terminating in a throat 16 through which the molten metal, fed by any suitable means into the space 2', may be caused to flow down into the bite of the rolls 1. The member 2 is generally of wedge shape in cross section but the lower parts of the side edges, indicated at 17 in Fig. 4, have a curvature similar to the outside curvature of the rolls 1. Thus upon the vertical adjustment of the member 2, the space between the cheeks 17 of the refractory member and the surfaces of the rolls 1 may be varied to control the thickness of a metal envelope formed by the solidification of a body of metal 4 contained between the refractory member 2 and the external surfaces of the rolls.

The core metal is poured into the wedge shaped space 2' and passes through the throat of the member 2 to form the metal core, as clearly indicated in Fig. 1; whereas the protective or external metal 4 is poured into the space surrounding the refractory member 2, where the metal contacts the cooling rolls 1 and solidifies, providing a solidified protective envelope which moves downward with the surfaces of the rolls 1 before it comes into contact with the core metal coming through the throat of the refractory member 2. The thickness of the protective coating is dependent upon the relative positions of the refractory block 2 and the cooling rolls 1. Even though this envelope may have been cooled considerably by the rolls 1 as it passes the cheeks 17, yet when it comes into contact with the molten body metal, the inside surfaces of the envelope metal will increase to a welding temperature, thereby forming a complete weld between metal portions derived from both sources, whether these metal portions be the same or dissimilar. I have illustrated my formed strip in Fig. 1 as comprising body metal 18 and external skins of protective metal 19 of different characteristics.

In order to prevent the flow of the metal 4 from the machine between the side surfaces of the rolls 6 and the curved surfaces of the rolls 1, I have provided blocks or dams 7 of a suitable shape to hold the molten metal within the space required. Preferably, these blocks are of refractory material so as to have no appreciable cooling effect upon the metal. Their general shape is shown in Fig. 5 where the side cheeks 20 of the dams are shaped to conform to the faces of the rolls 1, and centrally the blocks are grooved as at 21 to accept portions of the edging rolls 6, in a relationship most clearly shown in Fig. 3. The position of the blocks 7 may be maintained and varied by means of screws 8.

As shown at 22, additional cooling means for the strip edges may be employed inasmuch as the actual edges are in contact with the edging roll 6 for a very short distance only. A suitable means for this cooling may be, as shown, nozzles adapted to direct a cooling medium such as steam against the strip edges where these leave the rolls.

In the practice of my invention, the closest approach of the cooling surfaces of the rolls 1—1 and 6—6 determines the dimensions of the finished strip. The rolls are driven at such a speed as to prevent tearing or folding of the solidified metal skin as it enters the bite of the rolls, and the leaving speed of the strip 5 will preferably be the peripheral speed of the rolls. The molten metal from the same or different sources is fed in any suitable way to the two reservoir portions of my machine and the casting proceeds, as I have indicated above.

Modifications may be made in my invention without departing from the spirit thereof.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In direct casting apparatus the combination of opposed, cooled moving surfaces forming a confining pass, means for feeding molten metal to said surfaces, means adjacent said surfaces for confining the metal between said means and said surfaces so as to form on each surface a skin, which skins together form an envelope, and means within said confining means for feeding an addiitonal supply of metal into said envelope so as to be cooled by said surfaces and so as to form a composite article of which said skins constitute outer surfaces.

2. In direct casting apparatus the combination of opposed, cooled moving surfaces forming a confining pass, means for feeding molten metal to said surfaces, means adjacent said surfaces for confining the metal between said means and said surfaces so as to form on each surface a skin, which skins together form an envelope, and means within said confining means for feeding an additional supply of metal into said envelope so as to be cooled by said surfaces and so as to form a composite article of which said skins constitute outer surfaces, said means for feeding said additional supply of metal being so shaped as to keep said additional supply of metal away from said cooling surfaces during the initial formation of said skins.

3. In direct casting apparatus the combination of opposed, cooled moving surfaces forming a confining pass, means for feeding molten metal to said surfaces, means adjacent said surfaces for confining the metal between said means and said surfaces so as to form on each surface a skin, which skins together form an envelope, and means within said confining means for feeding an additional supply of metal into said envelope so as to be cooled by said surfaces and so as to form a composite article of which said skins constitute outer surfaces, said means for feeding said additional supply of metal being so shaped as to keep said additional supply of metal away from said cooling surfaces during the initial formation of said skins, said confining means at least being movable with respect to said cooling surfaces to permit control of the thickness of the skins formed on said surfaces.

4. In direct casting apparatus the combination of opposed, cooled moving surfaces forming a confining pass, means for feeding molten metal to said surfaces, means adjacent said surfaces for confining the metal between said means and said surfaces so as to form on each surface a skin, which skins together form an envelope, and means within said confining means for feeding an additional supply of metal into said envelope so as to be cooled by said surfaces and so as to form a composite article of which said skins constitute outer surfaces, said means for feeding said additional supply of metal being so shaped as to keep said additional supply of metal away from said cooling surfaces during the initial formation of said skins, and edging means for said apparatus comprising edgewise confining means for the molten metal.

5. In apparatus for the purpose described, the

combination of at least two cooled moving surfaces forming a confining pass, means for feeding molten metal to said surfaces, means for confining the metal to said surfaces so as to form thereon a skin or envelope, means for feeding an additional supply of metal therebetween so as to form a body contained within said envelope, edging means for said mechanism comprising edgewise confining means, for said first mentioned molten metal, of refractory material, and moving cooled surfaces operating past said confining means and contacting the edges of the article being cast.

6. In combination in direct casting apparatus, a pair of interspaced cooling cylinders forming a pass, dam means forming with said cylinders a reservoir, means within said reservoir having interspaced parts for effectively dividing said reservoir into a pair of outer reservoirs for molten metal located against said cylinders, and an intermediate reservoir, said parts being interspaced from said cylinders to permit feeding of molten metal from said outer reservoirs along the surfaces of said cylinders to form on each surface a cooled and solidified skin of metal, said intermediate reservoir having an opening below for feeding molten metal into said pass between said skins.

7. In combination, a pair of cooling cylinders forming a pass, dam means defining the width of said pass and forming with said rolls a reservoir for molten metal, isolating means located in said reservoir and defining an additonal reservoir for molten metal isolated from the first, whereby when molten metal is fed to said several reservoirs, a skin or envelope of solidified metal is first formed and then additional metal is fed therein to form a combined solidified structure as the metal leaves said pass, and cooled edging rolls extending into said pass and operating to cool the edges of said cast structure as it leaves said pass.

8. In combination, a pair of cooling cylinders forming a pass, dam means defining the width of said pass and forming with said rolls a reservoir for molten metal, isolating means located in said reservoir and defining an additional reservoir for molten metal isolated from the first, whereby when colten metal is fed to said several reservoirs, a skin or envelope of solidified metal is first formed and then additional metal is fed therein to form a combined solidified structure as the metal leaves said pass, and cooled edging rolls extending into said pass and operating to cool the edges of said cast structure as it leaves said pass, and additional means for cooling the cast article as it leaves said pass, said means comprising means for directing thereagainst a jet of cooling fluid.

EDWIN B. HUDSON.