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A request for correction of the pages 1, 2, 6 and 8 ("thick - thicknesses - thicker") should be replaced by ("wide - width - wider") has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 2.2).

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(54) Process and device for manufacturing very thick amorphous steel strips.

(57) The invention refers to a process and to the relevant device for manufacturing even very thick amorphous steel strips.
According to the invention, means are envisaged for feeding molten steel through an outlet device (139) ending at the bottom in a nozzle (131) elongated so as to form a slit.
Below this nozzle (131), a drum (4) rotating at a high speed and suitably cooled, receives the flow of molten steel.
The elongated slit-shaped nozzle (131) has at its two ends two electrodes (132, 133) capable of generating in the flow of steel passing through the nozzle (131) a suitable electric current, and around said nozzle, means (135, 136) capable of generating a magnetic field perpendicular to the flow direction of said electric current.

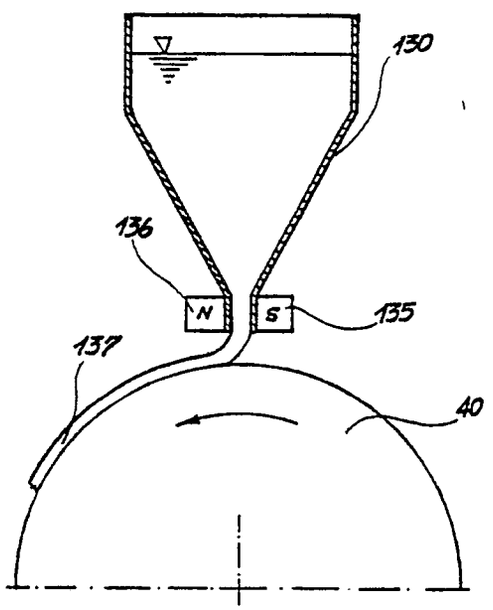

Fig. 3

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Process and device for manufacturing very thick amorphous steel strips

The subject-matter of this invention consists of a process and the related device for manufacturing very thick amorphous steel strips, particularly well suited for use in making transformers.

It is well-known that steel strips used for making transformers must be of the amorphous type.
This means that the strips obtained by rolling, inasmuch as they are commonly used for making transformers, do not have optimum characteristics from this point of view.
It has been proposed that amorphous steel strips of limited thicknesses, less than 15 mm, can be manufactured by continuous casting of the molten steel issuing from a tundish through a gauged slit onto a cooled rotating drum.

The above known process is schematically illustrated in figure 1, which shows a ladle 10 feeding a tundish 20. This tundish has at the bottom an outlet fitted with a slit-shaped nozzle which distributes a layer of the molten metal on a cylinder 40 rotating at a high speed and suitably cooled. The molten metal then solidifies on the surface of the cylinder, by which it is sent on a roller conveyor 60 to a coiler 50.
The unit indicated by 70 in figure 1 represents a measuring and control device which acts on the operational parameters of the process, both upstream and downstream from its position.

The weak points of the above known process, and due to which its applicability is limited to not very thick strips of amorphous steel (less than 15 mm), are first of all the difficulty of creating a sufficiently high pressure inside the tundish 20, and secondly the risk of freezing the flow of molten steel at the level of the slit-shaped nozzle.

This known method is therefore not suitable for manufacturing amorphous steel strips thicker than 15 mm.

According to the invention these difficulties can be overcome by means of an electromagnetic pumping system on the outlet nozzle for the molten steel.
The slit-shaped nozzle is made of a refractory material and has two electrodes, also refractory, at the two ends.
In addition, a strong magnetic field is created around the nozzle.
According to the invention, therefore, a thrust is created in the molten metal which is pushed through the slit-shaped nozzle.
In addition to this, the electric current passing through the molten metal heats it locally, so as to prevent partial solidification.

The basic features of the invention are summarized and schematically illustrated in the claims; its scopes and advantages are also indicated in the following description relating to forms of embodiment chosen by way of example only, with specific reference to the attached drawings, in which:

- as stated above, figure 1 shows a system of the known type, to which the invention may be advantageously applied;
- figure 2 is a cross-section of the claimed outlet device on a vertical plane at a right angle to the direction of flow of the strip of solidified metal;
- figure 3 is a schematic cross-section on III-III of figure 2 above.

Figure 1 has already been described in the introductory part of this description.

According to this invention, and as shown in detail in figures 2 and 3, the outlet 130 ends underneath in a narrow slit 131 made of refractory material, at the ends of which there are two electrodes 132 and 133 which generate an electric current of an intensity (I) and schematically represented by the arrows 134 through the flow of molten metal.
Along the elongated opposite edges of the slit 131 are arranged the poles 135 and 136 of a magnet which, combined with said current (I) generate a thrust in the molten metal coming out of the slit-shaped nozzle 131. The strip of molten metal is thus distributed in the known manner on the rotating cylinder 40 and is sent from here to a suitable coiler.
It should be noted that by choosing a suitable voltage to apply to the electrodes 132 and 133 and a suitable intensity of the magnetic field generated hy the magnet 135, 136, it is possible to impress any force on the strip of molten metal leaving the nozzle 131.
Furthermore, as mentioned above, the current (I) generates local heating which prevents undesired solidification of the flow of liquid steel in the slit 131.
Inversion of the voltage applied to the electrodes 132 and 132 allows closing or opening of the slit-shaped nozzle: in the first case the pumping of the liquid steel is reversed, and instead of descending it tends to rise towards a position of equilibrium, the idle state of which leads to the cooling and solidification of the steel in spite of the flow of electric current. Once the nozzle has been sealed due to the solidification, the current between the two electrodes may be shut off.
To open the nozzle, the direction of the current is reversed, and its intensity is increased until the locally solidified metal of the previous stage melts. The current is then returned to its normal operational values.

Claims

1) Process for manufacturing very thick amorphous steel strips, of the type which envisages feeding of molten steel in the form of a thin and transversally elongated flow and the subsequent cooling of said flow until a continuous strip is formed, characterized in that the necessary pumping effect is achieved on the flow of outgoing steel by means of an electric current passing through the the flow in a crosswise direction to the flow itself, and also by means of a simultaneous magnetic field, the intensity of which is directed at a right angle to the direction of the flow of said electric current.

2) Device suitable for implementing the process according to claim 1, of the type having a means of feeding the molten steel to an outlet device ending at the bottom in an elongated slit-shaped nozzle, and, below said slit-shaped nozzle a drum turning at high speed, suitably cooled, which receives the flow of molten steel leaving from the nozzle, characterized by the fact that said slit-shaped nozzle has at its ends two electrodes capable of generating a suitable electric current in the flow of steel passing through the nozzle, and around said nozzle means capable of generating a magnetic flow perpendicular to the direction in which said electric current flows.

3) Device according to the foregoing claim, characterized by the fact that the elongated poles of a magnet are fitted on the lips of the slit-shaped nozzle.

4) Device according to claims 2 and 3, characterized in that said nozzle is coated with a refractory metal, and that said electrodes are in turn made of refractory material.

5) Device according to claims 2 and 4, characterized by the fact that it envisages means for reversing the current delivered by the above electrodes.

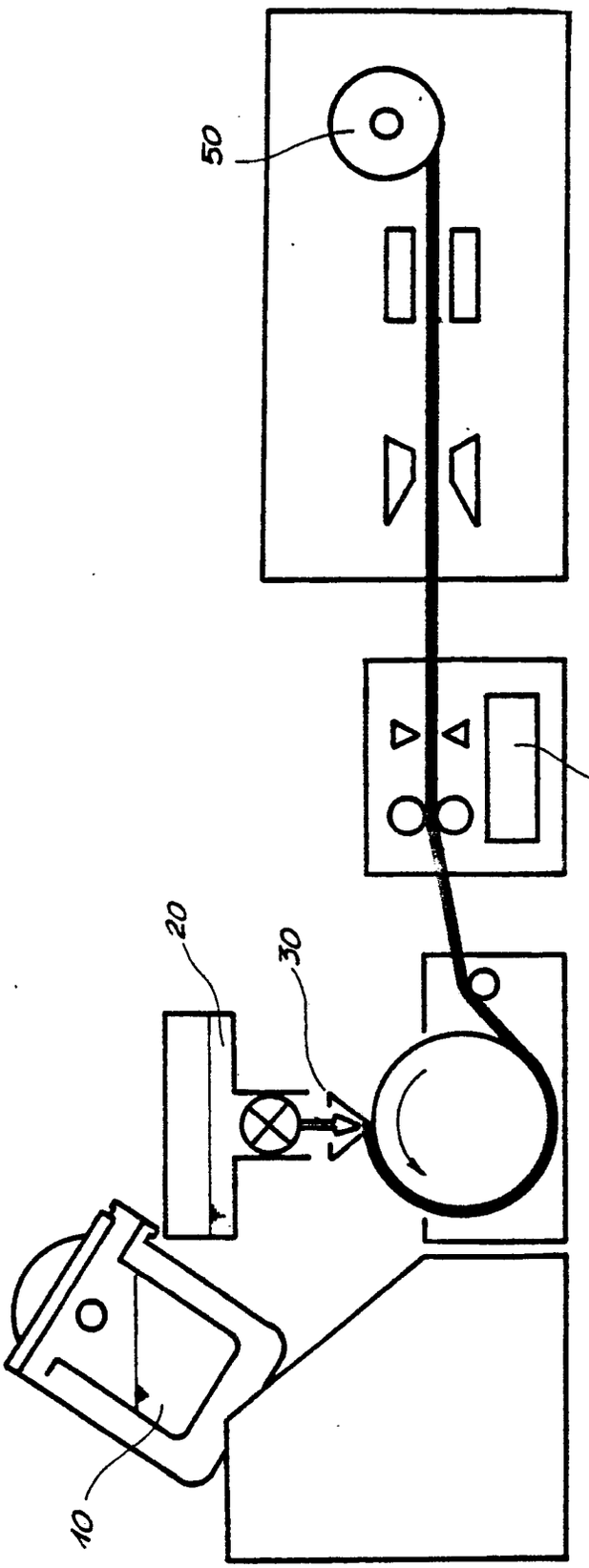

Fig. 1

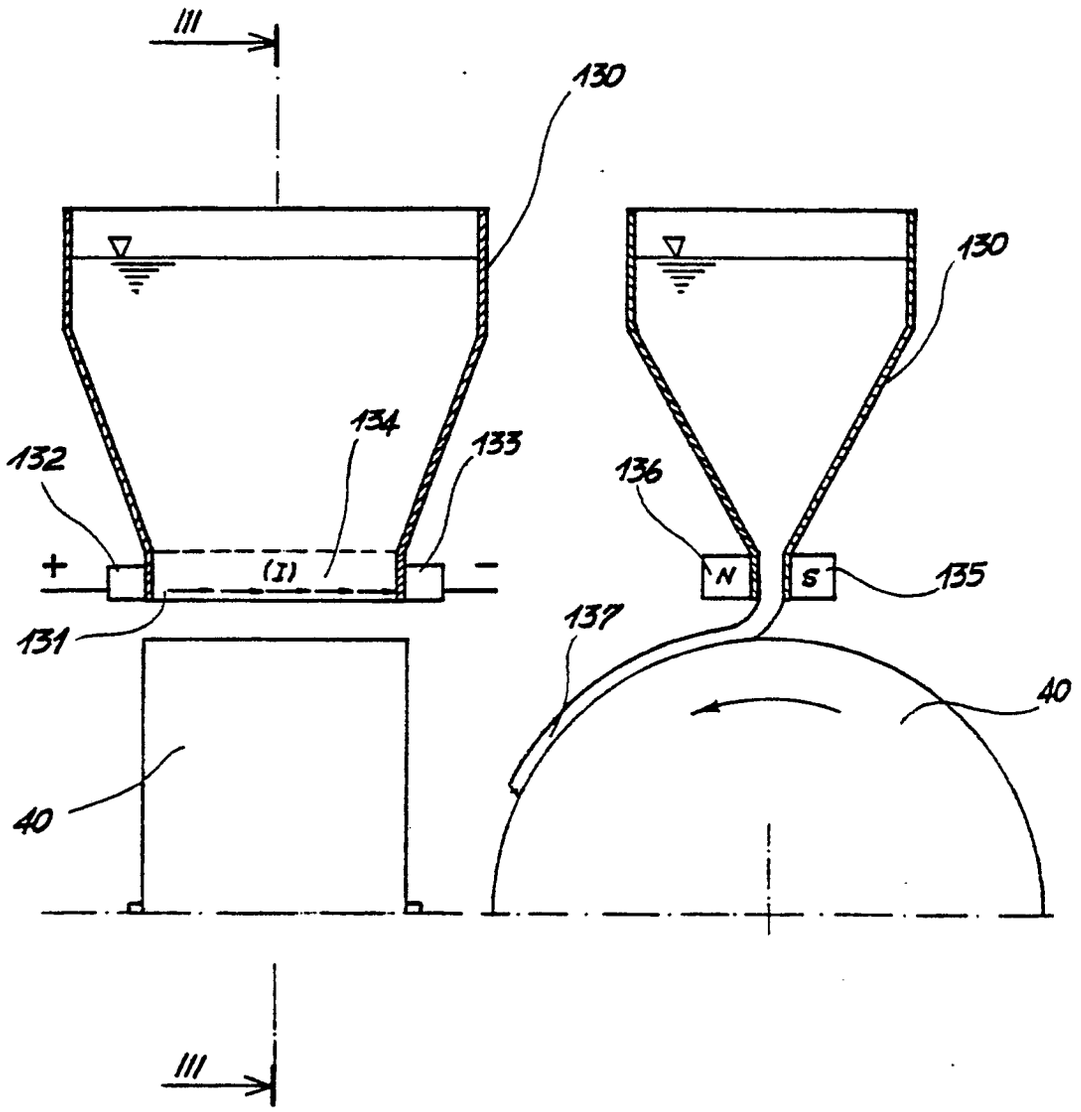

Fig. 2

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 83 0113

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	US-A-4 221 257 (M. C. NARASIMHAN) * figure 2 *	1	B 22 D 11/06
Y	DE-C- 476 812 (L. SZILARD) * claim 1 *	1	
A	EP-A-0 153 205 (USINOR)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 22 D 11/06

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	28-09-1989	SUTOR W

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
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