Claims

1. MACHINE FOR FORMING METAL BARS, in particular suitable for melting and the subsequent continuous solidification of precious metal such as gold, silver, precious alloys, as well as other pure metals or different alloys, in form of powder, grits or swarf of various sizes for producing inots having mass varying from 50g to 50 kg, said machine (100) being characterised in that it has six operating stations, arranged in succession wherein:

- in the first station (101), defined "loading area", there is present a pouring element "A", which deposits the solid metal in the ingot mould and a dosage element "B" adapted to allow adding a specific chemical additive which interacts with the crystalline structure of the material, there being present a pushing device for moving all ingot moulds forward over the entire operating cycle;

- in the second station (102), generally defined "melting furnace", there occurs the melting of the metal contained in the ingot mould, according to the predefined temperature/time parameters;

- in the third station (103), defined as "secondary addition", there is present a dosage element "C" which provides for depositing a chemical additive on the still liquid metal;

- in the fourth station (104), defined as "solidification area", there is present a channel or a cooling bath, whereby there occurs the solidification of the metal in the ingot mould, according to the predefined temperature/time parameters;

- in the fifth station (105), defined as "cooling area", there are present further means adapted to determine the cooling of the solid ingot as well as, when there is required a rapid cooling, a vat containing the cooling fluid, there further being provided means suitable for collecting the ingot when it is completely cooled;

- in the sixth station (106), defined as "unloading area", there are present means which allow unloading the ingot moulds, suitable to contain the ingots, in case of normal cooling, or are empty, in case of quick cooling and the cooled ingots are recovered separately.

2. OPERATION OF THE MACHINE FOR FORMING METAL BARS (100), obtained according to claim 1, said operation being characterised in that in the first operating station (101), on a loading surface there are positioned the empty ingot moulds (1), interposing between an ingot mould and the subsequent one or between groups of two or more mutually adjacent ingot moulds, spacers (2), made of graphite or any other refractory material, which have the function of maintaining a predefined distance between the single ingot moulds or between the groups of ingot moulds, so that the ingot moulds (1), forming a "train of ingot moulds", are positioned, during the forward movement, always correctly within the subsequent operating stations, said operating surface being also provided with a pushing device (3), driven variously, such as a worm screw, a pneumatic means, hydraulic means or any other means, which provides for pushing, with a predefined "pitch", the aforementioned train forward, and then returning and thus freeing space on the aforementioned loading surface, to allow depositing further empty ingot moulds.

3. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to claim 2, characterised in that in the first operating station (101), in each single ingot mould (1), there is poured an accurate amount of metal, in form of powder, grits or swarf of various sizes (pouring element A) and there is added a chemical additive (dosing element B), which creates a chemical reaction with the impurities contained in the metal and which is made up of Boric acid, Borax, Potassium Nitrates,

Ammonium, Sodium, Lithium and Potassium and Sodium Chlorides, used separately or mixed and then the cover (4) is positioned for closing the filled ingot mould.

4. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to claim 2, characterised in that the ingot mould (1) has a dimension in height such that, when it is filled with the exact weight of metal, the cover (4) thereof may rest on the metal, but remain raised with respect to the abutment of the edge of the ingot mould, this allowing the bottom of the cover to compress and thus regularly compact the powders, the grits or the swarf, so that, during the subsequent melting step, when the volume occupied by the mass of metal reduces gradually, even up to one third of the initial solid volume, the cover lowers progressively as the metal melts, until it rests on the aforementioned abutment, thus hermetically closing the ingot mould, said ingot mould (1) having an internal space made up of two distinct volumes and precisely the lower volume (1.1) constitutes the actual "mould", wherein there are determined the form and the dimensions of the ingot, according to the international LMBA standard or other specific requirements of the client and a second upper volume (1.2), which can be differently configured, with the aim of facilitating the deposit of the metal during the loading step.

5. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to one or more of claims 2 to 4, characterised in that the pushing device (3) pushes the "train" from the station (101) for supplying the ingot moulds (1) to the melting station (102), wherein there is present a heating furnace (5), in which the ingot moulds (1) and the spacers (2) slide on a refractory surface in absence of controlled atmosphere.

6. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to one or more of the preceding claims, characterised in that the pushing device (3) pushes the "train" from the station (101) for supplying the ingot moulds (1), to the

melting station (102), wherein there is present a tunnel (6), heated variously, preferably using the "induction" heating, the increase of the heating temperature (thermal gradient), occurring with at least two ramps, a quick ramp (a), up to reaching at least 90% of the set value of the melting temperature and one or more ramps (b.c) with a less inclined profile, wherein there is insufflated inert gas, such as Nitrogen, Nitrogen-Hydrogen mixture with max. 4.5% of Hydrogen (H), to create an "inert" environment, there being provided, at the lateral openings for the inlet and outlet of the "train", mobile partitions (7) obtained, preferably, with the guillotine technique.

7. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to one or more of claims 2 to 6, characterised in that, once the melting time elapses, the pushing device (3) moves the "train" forward so that the ingot moulds present on the loading surface are pushed into the furnace/tunnel (5/6) and these in turn push the ingot moulds present in the tunnel/furnace (5/6) to exit, then pass in the "secondary addition" station (103), wherein in each single ingot mould (1) there is added to the molten metal a chemical additive (dosing element C), which creates a chemical reaction with the impurities contained in the molten metal and which is made up of Boric acid, Borax, Potassium Nitrates, Ammonium, Sodium, Lithium and Potassium and Sodium Chlorides, used separately or mixed.

8. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to one or more of claims 2 to 7, characterised in that in the solidification station (104) the incandescent temperature ingot moulds containing the molten metal and closed by the cover slide until they stop on a cooling surface (10), cooled with water by means of passage holes present therewithin and made using copper, aluminium or alloys thereof or using other materials suitable for the controlled dispersion of heat, in which they remain for a predefined period of time, averagely 1 to 5 minutes, as a function of

the amount of material to be solidified, up to the complete solidification of the entire mass and in which there is created an "inert" environment, with introduction of a flow of inert gas such as Nitrogen, Argon or Nitrogen-Hydrogen mixture, which prevents the oxidation of the ingot moulds and of the covers and protects metal being solidified against oxygen.

9. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to one or more of claims 2 to 8, characterised in that the operations described in claims 7 and 8 are carried out in a single operating station (103/104).

10. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to one or more of claims 2 to 9, characterised in that in the cooling station (105) the ingot moulds, with the ingots still very hot, are subjected to a controlled cooling in a free environment and they are then sent to the unloading station (106).

11. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to one or more of claims 2 to 10, characterised in that in the cooling station (105) there is obtained a quick cooling, which provides for that the ingot moulds with the solid ingots still very hot, when they are in the cooling area, are emptied and the ingots fall into a cooling water vat (13), while the empty ingot moulds are sent to the unloading station (106).

12. MACHINE FOR FORMING METAL BARS, according to claim 1, characterised in that in the solidification station (104) the cooling plate (10) has a sliding surface, on which the ingot moulds stop in a solidification step, having a flat and smooth surface, or provided with millings in relief or recessed, the passage of the cooling fluid being executed longitudinally and/or transversely to the direction of movement of the "trains" of ingot moulds.

13. MACHINE FOR FORMING METAL BARS, according to claims 1 or 12, characterised in that in the solidification station (104), between the cooling surface (10) and the ingot mould (1), there are interposed other heating plates for slowing cooling (21), made of graphite, metal or refractory or insulating materials, smooth or provided with suitable millings in relief or recessed.

14. MACHINE FOR FORMING METAL BARS, operating according to claim 8, characterised in that in the solidification station (104) there are present cooling or thermal insulation plates (11), provided with notches for defining the localised heat areas, which are placed near or in contact with one or more sides of the ingot mould and the cover, furthermore there being provided, when there is required an accurate control of the thermodynamic solidification gradients, with the aim of obtaining an ingot with the most suitable solidified metal structure, the addition of heating panels (12) of the electrical resistor type, gas-type or heated with other means, also positioned around the ingot mould and on the cover.

15. OPERATION OF THE MACHINE FOR FORMING METAL BARS, according to claim 11, characterised in that the quick cooling provides for the raising of the cover (4) of the ingot mould (1), by means of grippers of the mechanical type, pneumatic type or any other type, while actuators of the mechanical type, pneumatic type or any other type hold the aforementioned ingot mould; then the aforementioned actuators rotating and tilting the ingot mould and, by gravity, the hot ingot falls into a basket (14), which is submerged in a cooling vat (13).

16. OPERATION OF THE MACHINE FOR FORMING METAL BARS, as described in claim 12, characterised in that, after a suitable cooling time, through a translation movement, the basket (14) exits from the vat (13), to allow the collection of the cooled ingot (20) and, still subsequently, there occurs the repositioning of the

empty basket (14), the repositioning of the empty ingot moulds and the lowering of the covers and, still subsequently, the head pushing device (2) moves the "train" forward, so that the empty ingot mould, sliding, ends up positioned in the unloading station (106), from where it is collected together with the ingot(20).

Claims

1. MACHINE FOR FORMING METAL BARS, in particular suitable for melting and the subsequent continuous solidification of precious metal such as gold, silver, precious alloys, as well as other pure metals or different alloys, in form of powder, grits or swarf of various sizes for producing ingots having mass varying from 50g to 50 kg, said machine (100) being characterised in that it has six operating stations, arranged in succession wherein:

- in the first station (101), defined "loading area", there is present a pouring element "A", which deposits the solid metal in the ingot mould (1) and a dosage element "B" adapted to allow adding a specific chemical additive which interacts with the crystalline structure of the material, there being present a pushing device (3) for moving all ingot moulds forward over the entire operating cycle, being also provided a cover (4) for closing the filled ingot mould and being provided spacers (2) made of refractory material which have the function of maintaining a predefined distance between the single ingot mould or between the groups of ingot moulds;
- in the second station (102), generally defined "melting furnace", there occurs the melting of the metal contained in the ingot mould, according to the predefined temperature/time parameters;
- in the third station (103), defined as "secondary addition", there is present a dosage element "C" which provides for depositing a chemical additive on the still liquid metal;
- in the fourth station (104), defined as "solidification area", there is present a channel or a cooling bath, whereby there occurs the solidification of the metal in the ingot mould, according to the predefined temperature/time parameters;
- in the fifth station (105), defined as "cooling area", there are present further means adapted to determine the cooling of the solid ingot as well as, when there is required

a rapid cooling, a vat containing the cooling fluid, there further being provided means suitable for collecting the ingot when it is completely cooled;

- in the sixth station (106), defined as "unloading area", there are present means which allow unloading the ingot moulds, suitable to contain the ingots, in case of normal cooling, or are empty, in case of quick cooling and the cooled ingots are recovered separately.

2. MACHINE, obtained according to claim 1, characterised in that in the first operating station (101), on a loading surface there are positioned the empty ingot moulds (1), interposing between an ingot mould and the subsequent one or between groups of two or more mutually adjacent ingot moulds, spacers (2), made of graphite or any other refractory material, which have the function of maintaining a predefined distance between the single ingot moulds or between the groups of ingot moulds, so that the ingot moulds (1), forming a "train of ingot moulds", are positioned, during the forward movement, always correctly within the subsequent operating stations, said operating surface being also provided with a pushing device (3), driven variously, such as a worm screw, a pneumatic means, hydraulic means or any other means, which provides for pushing, with a predefined "pitch", the aforementioned train forward, and then returning and thus freeing space on the aforementioned loading surface, to allow depositing further empty ingot moulds.

3. MACHINE, according to claim 2, characterised in that in the first operating station (101), there are means able to pour in each single ingot mould (1) an accurate amount of metal, in form of powder, grits or swarf of various sizes and there is added a chemical additive, which creates a chemical reaction with the impurities contained in the metal and which is made up of Boric acid, Borax, Potassium Nitrates, Ammonium, Sodium, Lithium and Potassium and Sodium Chlorides, used separately or mixed and then the cover (4) is positioned for closing the filled ingot mould.

4. MACHINE, according to claim 2, characterised in that the ingot mould (1) has a dimension in height such that, when it is filled with the exact weight of metal, the cover (4) thereof may rest on the metal, but remain raised with respect to the abutment of the edge of the ingot mould, this allowing the bottom of the cover to compress and thus regularly compact the powders, the grits or the swarf, so that, during the subsequent melting step, when the volume occupied by the mass of metal reduces gradually, even up to one third of the initial solid volume, the cover lowers progressively as the metal melts, until it rests on the aforementioned abutment, thus hermetically closing the ingot mould, said ingot mould (1) having an internal space made up of two distinct volumes and precisely the lower volume (1.1) constitutes the actual "mould", wherein there are determined the form and the dimensions of the ingot, according to the international LMBA standard or other specific requirements of the client and a second upper volume (1.2), which can be differently configured, with the aim of facilitating the deposit of the metal during the loading step.

5. MACHINE, according to one or more of claims 2 to 4, characterised in that in the melting station (102) is present a heating furnace (5), in which the ingot moulds (1) and the spacers (2) slide on a refractory surface in absence of controlled atmosphere.

6. MACHINE, according to one or more of the preceding claims, characterised in that in the melting station (102) there is present a tunnel (6), heated variously, preferably using the "induction" heating, the increase of the heating temperature, occurring with at least two ramps, a quick ramp (a), up to reaching at least 90% of the set value of the melting temperature and one or more ramps (b.c) with a less inclined profile, wherein there is insufflated inert gas, such as Nitrogen, Nitrogen-Hydrogen mixture with max. 4.5% of Hydrogen (H), to create an "inert" environment, there being provided, at the lateral openings for the inlet and outlet of the "train", mobile partitions (7) obtained, preferably, with the guillotine technique.

7. MACHINE FOR FORMING METAL BARS, according to claim 1, characterised in that in the solidification station (104) the cooling plate (10) has a sliding surface, on which the ingot moulds stop in a solidification step, the passage of the cooling fluid being executed longitudinally and/or transversely to the direction of movement of the "trains" of ingot moulds.

8. MACHINE FOR FORMING METAL BARS, according to claim 7, characterised in that in the solidification station (104), between the cooling surface (10) and the ingot mould (1), there are interposed other heating plates for slowing cooling (21), made of graphite, metal or refractory or insulating materials, that can be provided with suitable millings in relief or recessed.

9. MACHINE FOR FORMING METAL BARS, operating according to claim 8, characterised in that in the solidification station (104) there are present cooling or thermal insulation plates (11), provided with notches for defining the localised heat areas, which are placed near or in contact with one or more sides of the ingot mould and the cover, furthermore there being provided, when there is required an accurate control of the thermodynamic solidification gradients, with the aim of obtaining an ingot with the most suitable solidified metal structure, the addition of heating panels (12) of the electrical resistor type, gas-type or heated with other means, also positioned around the ingot mould and on the cover.

10. OPERATION OF THE MACHINE FOR FORMING METAL BARS, as described in claims 2 and 6, characterised in that, once the melting time elapses, the pushing device (3) moves the "train" forward so that the ingot moulds present on the loading surface are pushed into the furnace/tunnel (5/6) and these in turn push the ingot moulds present in the tunnel/furnace (5/6) to exit, then pass in the "secondary addition" station (103), wherein in each single ingot mould (1) there is added to the molten metal a chemical additive, which creates a chemical reaction with the

impurities contained in the molten metal and which is made up of Boric acid, Borax, Potassium Nitrates, Ammonium, Sodium, Lithium and Potassium and Sodium Chlorides, used separately or mixed.

11. OPERATION OF THE MACHINE FOR FORMING METAL BARS, as described in one or more of claims 2 to 6, characterised in that in the solidification station (104) the incandescent temperature ingot moulds containing the molten metal and closed by the cover slide until they stop on a cooling surface (10), cooled with water by means of passage holes present therewithin and made using copper, aluminium or alloys thereof or using other materials suitable for the controlled dispersion of heat, in which they remain for a predefined period of time, averagely 1 to 5 minutes, as a function of the amount of material to be solidified, up to the complete solidification of the entire mass and in which there is created an "inert" environment, with introduction of a flow of inert gas such as Nitrogen, Argon or Nitrogen-Hydrogen mixture, which prevents the oxidation of the ingot moulds and of the covers and protects metal being solidified against oxygen.

12. OPERATION OF THE MACHINE FOR FORMING METAL BARS as described in one or more of claims 1 to 6, characterised in that the operations made in the third and fourth station (103/104) are carried out in a single operating station.

13. OPERATION OF THE MACHINE FOR FORMING METAL BARS, as described in one or more of claims 2 to 6, characterised in that in the cooling station (105) the ingot moulds, with the ingots still very hot, are subjected to a controlled cooling and they are then sent to the unloading station (106).

14. OPERATION OF THE MACHINE FOR FORMING METAL BARS, as described in one or more of claims 2 to 6, characterised in that in the cooling station (105) there is obtained a quick cooling, which provides for that the ingot moulds with the solid ingots still very hot, when they are in the cooling area, are emptied and the

ingots fall into a cooling water vat (13), while the empty ingot moulds are sent to the unloading station (106).

15. OPERATION OF THE MACHINE FOR FORMING METAL BARS, as described in claim 11, characterised in that the quick cooling provides for the raising of the cover (4) of the ingot mould (1), by means of grippers of the mechanical type, pneumatic type or any other type, while actuators of the mechanical type, pneumatic type or any other type hold the aforementioned ingot mould; then the aforementioned actuators rotating and tilting the ingot mould and, by gravity, the hot ingot falls into a basket (14), which is submerged in a cooling vat (13).

16. OPERATION OF THE MACHINE FOR FORMING METAL BARS, as described in claim 12, characterised in that, after a suitable cooling time, through a translation movement, the basket (14) exits from the vat (13), to allow the collection of the cooled ingot (20) and, still subsequently, there occurs the repositioning of the empty basket (14), the repositioning of the empty ingot moulds and the lowering of the covers and, still subsequently, the head pushing device (2) moves the "train" forward, so that the empty ingot mould, sliding, ends up positioned in the unloading station (106), from where it is collected together with the ingot(20).

Claims

1. **Machine for forming metal bars**, in particular suitable for melting and the subsequent continuous solidification of precious metal such as gold, silver, precious alloys, as well as other pure metals or different alloys, in form of powder, grits or swarf of various sizes for producing ingots having mass varying from 50g to 50 kg, said machine (100) being characterised in that it has six operating stations, arranged in succession wherein:

- in the first station (101), defined "loading area", there is present a pouring element "A", which deposits the solid metal in the ingot mould and a dosage element "B" adapted to allow adding a specific chemical additive which interacts with the crystalline structure of the material, there being present a pushing device for moving all ingot moulds forward over the entire operating cycle;
- in the second station (102), generally defined "melting furnace", there occurs the melting of the metal contained in the ingot mould, according to the predefined temperature/time parameters;
- in the third station (103), defined as "secondary addition", there is present a dosage element "C" which provides for depositing a chemical additive on the still liquid metal;
- in the fourth station (104), defined as "solidification area", there is present a channel or a cooling bath, whereby there occurs the solidification of the metal in the ingot mould, according to the predefined temperature/time parameters;
- in the fifth station (105), defined as "cooling area", there are present further means adapted to determine the cooling of the solid ingot as well as, when there is required a rapid cooling, a vat containing the cooling fluid, there further being provided means suitable for collecting the ingot when it is completely cooled;

- in the sixth station (106), defined as "unloading area", there are present means which allow unloading the ingot moulds, suitable to contain the ingots, in case of normal cooling, or are empty, in case of quick cooling and the cooled ingots are recovered separately.

2. **Machine** according to claim 1, characterised in that in the first operating station (101), on a loading surface there are positioned the empty ingot moulds (1), interposing between an ingot mould and the subsequent one or between groups of two or more mutually adjacent ingot moulds, spacers (2), made of graphite or any other refractory material, which have the function of maintaining a predefined distance between the single ingot moulds or between the groups of ingot moulds, so that the ingot moulds (1), forming a "train of ingot moulds", are positioned, during the forward movement, always correctly within the subsequent operating stations, said operating surface being also provided with a pushing device (3), driven variously, such as a worm screw, a pneumatic means, hydraulic means or any other means, which provides for pushing, with a predefined "pitch", the aforementioned train forward, and then returning and thus freeing space on the aforementioned loading surface, to allow depositing further empty ingot moulds.

3. **Machine**, according to claim 2, characterised in that in the first operating station (101), in each single ingot mould (1), there is poured an accurate amount of metal, in form of powder, grits or swarf of various sizes (pouring element A) and there is added a chemical additive (dosing element B), which creates a chemical reaction with the impurities contained in the metal and which is made up of Boric acid, Borax, Potassium Nitrates, Ammonium, Sodium, Lithium and Potassium and Sodium Chlorides, used separately or mixed and then **a** cover (4) is positioned for closing the filled ingot mould.

4. **Machine**, according to claim 2, characterised in that the ingot mould (1) has a dimension in height such that, when it is filled with the exact weight of metal, **a** cover (4) thereof may rest on the metal, but remain raised with respect to the abutment of the edge of the ingot mould, this allowing the bottom of the cover to compress and thus regularly compact the powders, the grits or the swarf, so that, during the subsequent melting step, when the volume occupied by the mass of metal reduces gradually, even up to one third of the initial solid volume, the cover lowers progressively as the metal melts, until it rests on the aforementioned abutment, thus hermetically closing the ingot mould, said ingot mould (1) having an internal space made up of two distinct volumes and precisely the lower volume (1.1) constitutes the actual "mould", wherein there are determined the form and the dimensions of the ingot, according to the international LMBA standard or other specific requirements of the client and a second upper volume (1.2), which can be differently configured, with the aim of facilitating the deposit of the metal during the loading step.

5. **Machine**, according to one or more of claims 2 to 4, characterised in that the pushing device (3) pushes the "train" from the station (101) for supplying the ingot moulds (1) to the melting station (102), wherein there is present a heating furnace (5), in which the ingot moulds (1) and the spacers (2) slide on a refractory surface in absence of controlled atmosphere.

6. **Machine**, according to one or more of the preceding claims, characterised in that the pushing device (3) pushes the "train" from the station (101) for supplying the ingot moulds (1), to the melting station (102), wherein there is present a tunnel (6), heated variously, preferably using the "induction" heating, the increase of the heating temperature (thermal gradient), occurring with at least two ramps, a quick ramp (a), up to reaching at least 90% of the set value of the melting temperature and one or more

ramps (b.c) with a less inclined profile, wherein there is insufflated inert gas, such as Nitrogen, Nitrogen-Hydrogen mixture with max. 4.5% of Hydrogen (H), to create an "inert" environment, there being provided, at the lateral openings for the inlet and outlet of the "train", mobile partitions obtained, preferably, with the guillotine technique.

7. **Machine**, according to one or more of claims 2 to 6, characterised in that, once the melting time elapses, the pushing device (3) moves the "train" forward so that the ingot moulds present on the loading surface are pushed into the furnace/tunnel (5/6) and these in turn push the ingot moulds present in the tunnel/furnace (5/6) to exit, then pass in the "secondary addition" station (103), wherein in each single ingot mould (1) there is added to the molten metal a chemical additive (dosing element C), which creates a chemical reaction with the impurities contained in the molten metal and which is made up of Boric acid, Borax, Potassium Nitrates, Ammonium, Sodium, Lithium and Potassium and Sodium Chlorides, used separately or mixed.

8. **Machine**, according to one or more of claims 2 to 7, characterised in that in the solidification station (104) the incandescent temperature ingot moulds containing the molten metal and closed by the cover slide until they stop on a cooling surface (10), cooled with water by means of passage holes present therewithin and made using copper, aluminium or alloys thereof or using other materials suitable for the controlled dispersion of heat, in which they remain for a predefined period of time, averagely 1 to 5 minutes, as a function of the amount of material to be solidified, up to the complete solidification of the entire mass and in which there is created an "inert" environment, with introduction of a flow of inert gas such as Nitrogen, Argon or Nitrogen-Hydrogen mixture, which prevents the oxidation of the ingot moulds and of the covers and protects metal being solidified against oxygen.

9. **Machine**, according to one or more of claims 2 to 8, characterised in that the operations described in claims 7 and 8 are carried out in a single operating station (103/104).

10. **Machine**, according to one or more of claims 2 to 9, characterised in that in the cooling station (105) the ingot moulds, with the ingots still very hot, are subjected to a controlled cooling in a free environment and they are then sent to the unloading station (106).

11. **Machine**, according to one or more of claims 2 to 10, characterised in that in the cooling station (105) there is obtained a quick cooling, which provides for that the ingot moulds with the solid ingots still very hot, when they are in the cooling area, are emptied and the ingots fall into a cooling water vat (13), while the empty ingot moulds are sent to the unloading station (106).

12. **Machine**, according to claim 1 , characterised in that in the solidification station (104) the cooling plate (10) has a sliding surface, on which the ingot moulds stop in a solidification step, having a flat and smooth surface, or provided with millings in relief or recessed, the passage of the cooling fluid being executed longitudinally and/or transversely to the direction of movement of the "trains" of ingot moulds.

13. **Machine**, according to claims 1 or 12, characterised in that in the solidification station (104), between the cooling surface (10) and the ingot mould (1), there are interposed other heating plates for slowing cooling (21), made of graphite, metal or refractory or insulating materials, smooth or provided with suitable millings in relief or recessed.

14. **Machine**, operating according to claim 8, characterised in that in the solidification station (104) there are present cooling or thermal insulation plates (1 1), provided with notches for defining the localised heat areas, which are placed near or in contact with

one or more sides of the ingot mould and the cover, furthermore there being provided, when there is required an accurate control of the thermodynamic solidification gradients, with the aim of obtaining an ingot with the most suitable solidified metal structure, the addition of heating panels (12) of the electrical resistor type, gas-type or heated with other means, also positioned around the ingot mould and on the cover.

15. **Machine**, according to claim 11 , characterised in that the quick cooling provides for the raising of the cover (4) of the ingot mould (1), by means of grippers of the mechanical type, pneumatic type or any other type, while actuators of the mechanical type, pneumatic type or any other type hold the aforementioned ingot mould; then the aforementioned actuators rotating and tilting the ingot mould and, by gravity, the hot ingot falls into a basket (14), which is submerged in a cooling vat (13).

16. **Machine**, as described in claim 12, characterised in that, after a suitable cooling time, through a translation movement, the basket (14) exits from the vat (13), to allow the collection of the cooled ingot (20) and, still subsequently, there occurs the repositioning of the empty basket (14), the repositioning of the empty ingot moulds and the lowering of the covers and, still subsequently, the head pushing device (2) moves the "train" forward, so that the empty ingot mould, sliding, ends up positioned in the unloading station (106), from where it is collected together with the ingot (20).