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PROCESS FOR CASTING METAL INGOTS AND DEVICES THERETO

Filed Sept. 4, 1937

Serial No. 162,538

3 Sheets-Sheet 1

Fig.1

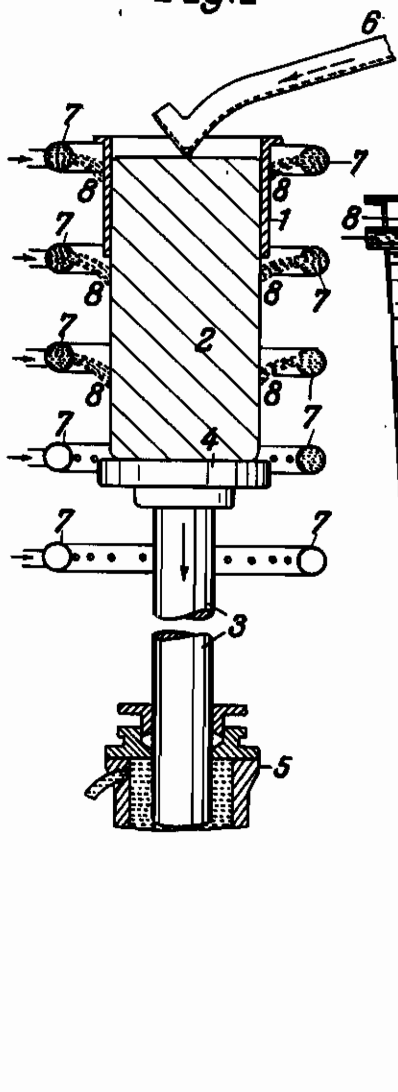
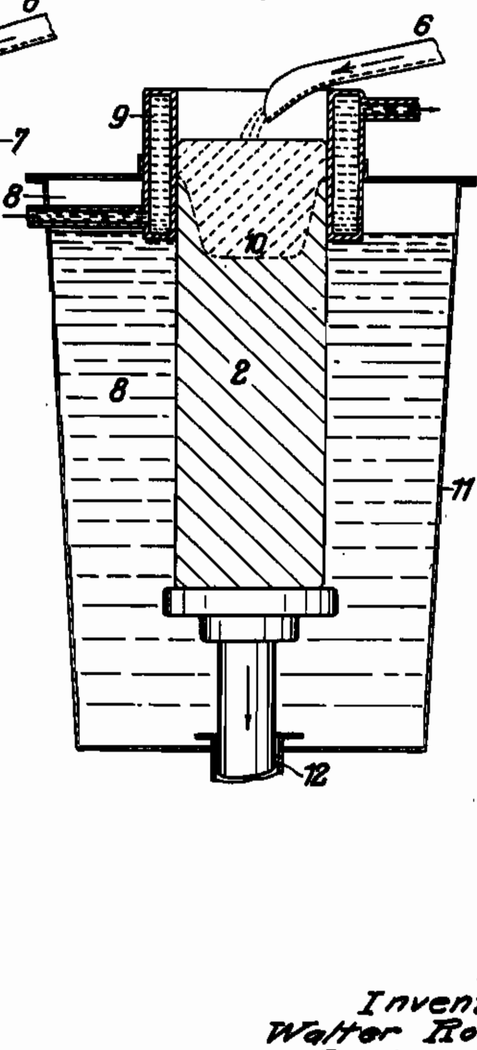


Fig.2



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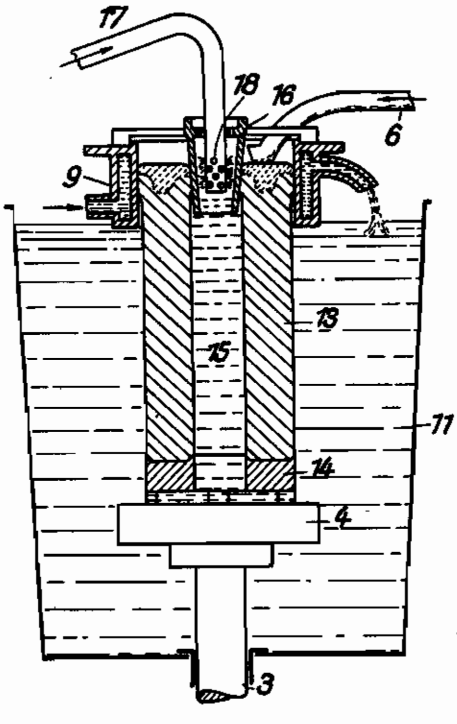

Fig. 3

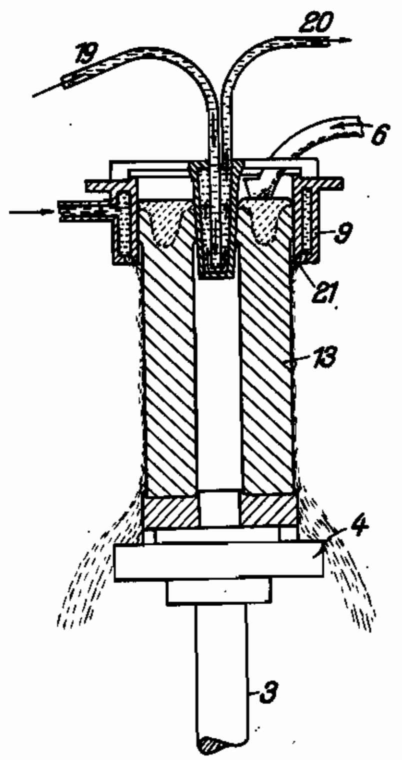

Fig. 4

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3 Sheets-Sheet 3

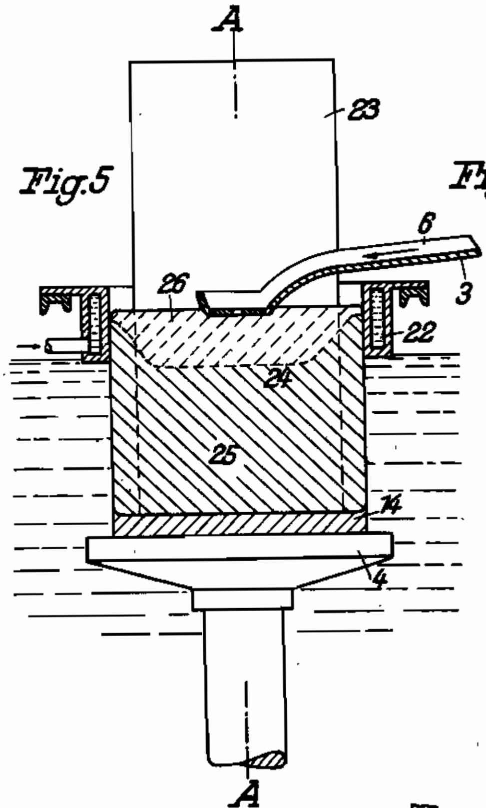

Fig.5

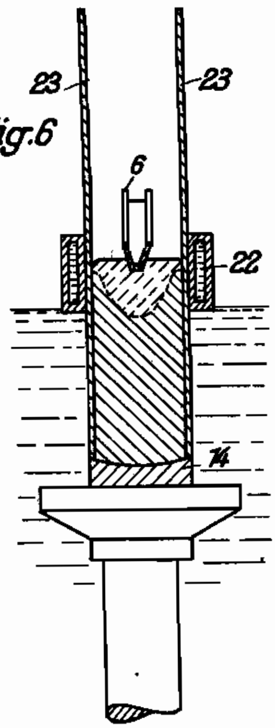

Fig.6

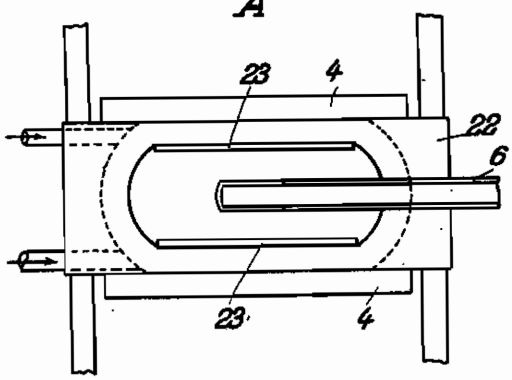

Fig.7

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ALIEN PROPERTY CUSTODIAN

PROCESS FOR CASTING METAL INGOTS AND DEVICES THERETO

Walter Roth and Otto Reuleaux, Hannover, Germany; vested in the Alien Property Custodian

Application filed September 4, 1937

A process for casting metal ingots and devices thereto.

The invention relates to a process of making metal ingots and comprises a device for executing this process. In particular this invention refers to the production of ingot castings which are free from pipings, enclosures and segregations.

The invention further comprises a process of casting in which a particularly high rate of cooling in the vertical direction is achieved.

It further comprises the production of hollow ingots likewise free from pipings, enclosures and segregations.

An further object of the invention comprises the production of plated ingots in which the core-material is poured in a liquid state inside the plating material, which is laid along the walls of the mould, without incurring the danger of its melting.

Further objects of the invention as well as the attained advantages will become apparent from the following descriptions.

In the attached drawing the apparatus, by means of which the process is carried out, is shown diagrammatically. Figs. 1 and 2 show a vertical section through a casting device for the execution of this process. Figs. 3 and 4 show vertical sections through the device used for producing hollow ingots, while Figs. 5 and 6 show vertical sections through the device for producing the plated material. Fig. 7 is a cross section through the device shown in Fig. 5. In Fig. 1, **1** is the wall of the mould, **2** is the cast ingot which can be lowered slowly by means of the bottom **4** of the mould which is attached to the plunger **3**. This is moved by an hydraulic device **5**, not described in detail, which may be constructed ad libitum. **6** is the feeder through which the molten material passes into the mould. A cooling liquid **6** passes through the pipes **7** and from there partly through the walls of the mould and partly against the solidifying ingot.

In Fig. 2, **9** is a double-walled water-cooled mould through which the cooling liquid **8** flows. **2** is again the ingot, which is however divided into two parts by a dotted line **10** of which the top, hatched the other way, is the still liquid part, while the bottom part has already solidified. The plunger and the ingot are surrounded by a container **11** which also contains the cooling liquid **8**. The packings **12** allow the plunger to move through the box without letting the water flow out.

In Fig. 3, **9** is again the watercooled mould, **3** the plunger which moves the bottom **4** of the mould. The hollow ingot **13** is cast as before, by means of the feeder **6**. **14** is a false bottom onto which the material is cast at first. Through a not shown opening the cooling water can enter this false bottom and flow into the hollow part **15**. **16** is a hollow cylinder which is cooled with cooling water supplied through the pipe **17** and the jets **18**.

In Fig. 4 the inner cooled mandrel has a special construction. Here the cooling water is fed in by the pipe **19** and is led out by the pipe **20**. The mould **9** has holes **21** at the bottom through which the cooling water trickles down the ingot.

In Fig. 5, **22** is the cooled mould, which however in contrast with the other cylindrical ingots, shown in the other illustrations, is oval in cross-section. **6** is again a feeder, while **23** is the plating material laid against the walls of the mould. The line **24** again shows the boundary between the solidified part **25** of the ingot and the still liquid part **26**. Fig. 6 is a section along the line A—A in Fig. 5 and shows the casting device in a vertical section of the narrow side.

The process according to the invention is carried out as follows: First the bottom **4**, on the top of which the false bottom **14** may be placed, is raised to the bottom rim of the comparatively short mould by means of the plunger **3**. The height of the mould should by preference be smaller than the diameter of the ingot at the narrowest part. As soon as the bottom has reached the lower rim of the mould, liquid metal is poured incontinuously through the feeder **6** until it fills the mould almost to the brim. At the same time the cooling of the walls of the mould is started. To make this as great as possible it is important that the walls of the mould are not too thick and are made of a metal of good heat conductivity e. g. copper or aluminium. The cooling of the mould which may be achieved either by spraying or by letting the cooling water flow through a double wall, makes the ingot solidify superficially at least along the edges. As soon as the mould is almost filled, the bottom is let down gradually in such a way, that the level of the liquid in the mould remains constant. The invention requires that the casting is done so fast, and the mould is so short, that the ingot which leaves the mould at the bottom, is not yet solidified at the centre, and that the complete solidification is brought about by the cooling water which acts immediately on the superficially solidified ingot. Thus it is achieved that the solidification of the centre part of the ingot takes place mainly in an upward direction, keeping up with the solidification of the surface. In contrast to the moulds used so far, there is no partition-wall between the cooling water and the ingot as it leaves the mould so that the cooling achieved is far greater than hitherto. The ingot thus gets a fine grain, and segregations and pipings are far better eliminated than with the previous methods.

The shortness of the mould has the further unexpected advantage that the ingot sinks by its own weight. This is further enhanced by the severe cooling of the walls of the mould from below which brings about a certain contraction of the solidified outer zones, so that the ingot is loosened from the walls of the mould. This loosening is particularly advantageous with the casting of aluminum and aluminum alloys, because these metals contract in a very great degree. If other metals with a smaller contraction coefficient are to be cast, it is advisable, to give the mould a slightly conical shape with a taper of up to 1% according to the total diameter of the ingot and the kind of metal to be cast. It is further advisable to paint for instance the walls of the mould with graphite to facilitate the sliding of the ingot.

In contrast to all other processes this invention requires no device for drawing down the ingot, either by fitting the bottom with a special device for pouring in the metal, or by using rollers to pull down the ingot. As soon as the plunger has reached its lowest point the casting is stopped and the ingot taken out.

If hollow ingots are to be cast a short hollow cooled mandrel is fixed in the centre of the mould which serves to keep open a hole in the centre of the ingot. Otherwise everything is done as described before. This hollow cooling mandrel has a strong taper, so that it is impossible for the ingot to shrink onto it. Here again the combination of the short mould with the severe cooling from below makes it possible to use such a hollow mandrel without running the risk of getting cracks.

It has proved particularly advantageous to plate ingots by means of a casting process as described above. This is carried out as follows: The false bottom **14** and the plates **23** are set on the casting table when the casting begins. The plates are welded together by the hot metal which however remains liquid for only a short time; the severe cooling from below cools them down so quickly that it is impossible for them to melt through.

Example

As an example it may be stated that on casting aluminum alloys containing about 3,5–4,5% copper and small quantities of magnesium and manganese, very good ingots are obtained, if the diameter of the ingots is about 250–300 mm and the height of the mould 160–200 mm. The metal was let in with the usual casting temperature, as far as about 4–5 cm from the top rim of the mould and then the bottom lowered with a speed of 50–90 cm/min. It was found that in this case the liquid metal in the centre of the ingot had a depth of about 150–200 mm so that the block was still liquid in the centre on leaving the mould while its immersed walls were completely solidified by the cooling water in contact with them. The cooling water itself circulated continually and was about handwarm. The outside surface of the cast ingot was so smooth and free of segregations that cuttings from it could be put straight into the recipients of the strap presses for pressing.

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