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[54] **CASTING APPARATUS WITH SLIDABLY MOUNTED BRANCH RUNNERS**

[75] Inventors: **Pal Palovits,** Ajka; **Tiborne Laar,** Budapest; **Endre Mucsy,** Budapest; **Tibor Laar,** Budapest; **Janos Harmath,** Ajka, all of Hungary

[73] Assignee: **Femipari Kutato Intezet,** Budapest and Ajka, Hungary

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[51] **Int. Cl.** **B22d 35/04**

[58] **Field of Search** 249/110, 108; 164/129, 164/133, 337; 141/244, 284, 387

[56] **References Cited**

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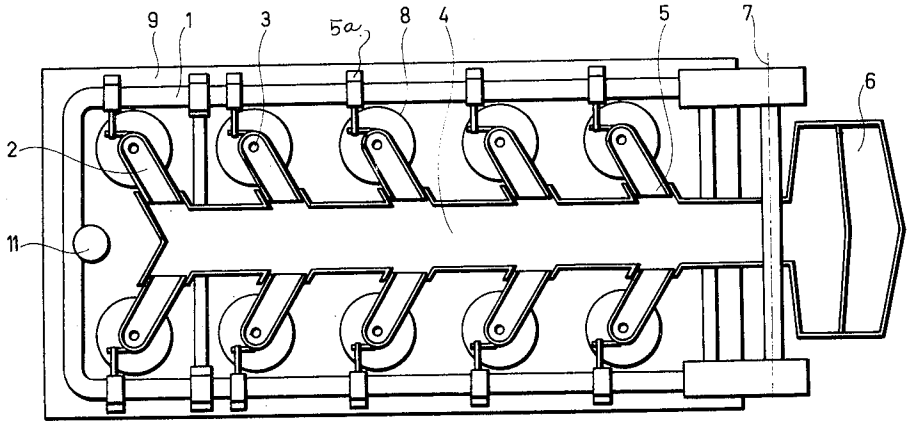
Primary Examiner—Robert D. Baldwin

Attorney, Agent, or Firm—Young and Thompson

[57] **ABSTRACT**

Apparatus for simultaneously casting a plurality of aluminum ingots comprises a vertically swinging metal frame of substantially zero coefficient of thermal expansion, supported above an elongated series of molds. A main runner for molten aluminum extends lengthwise of the frame and the series of molds. A container supplies molten aluminum to the main runner. To solve the problems of thermal expansion of the main runner, branch runners, one individual to each mold, are supported not by the main runner but rather by the frame and are movable relative to the main runner. Downward vertical swinging movement of the assembly feeds molten aluminum to the runners, while upward swinging movement of the assembly returns excess aluminum to the container. As a result, ingots of uniform size, good surface quality and uniform crystalline properties are achieved.

7 Claims, 2 Drawing Figures



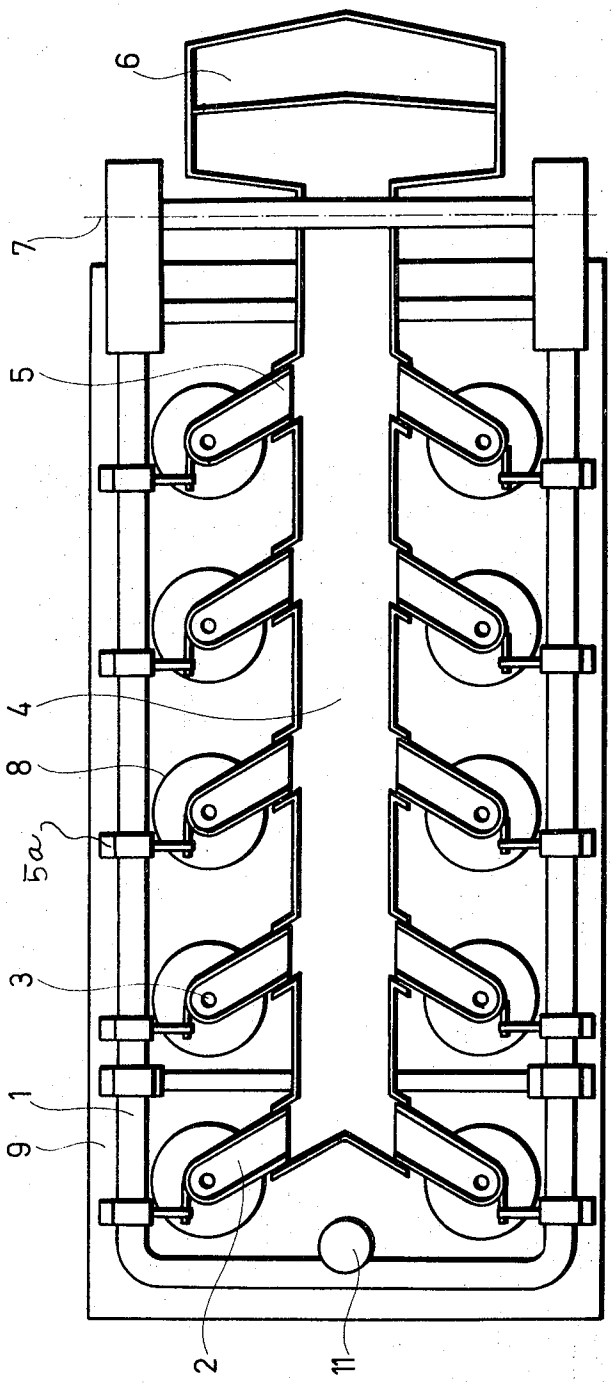


Fig.1

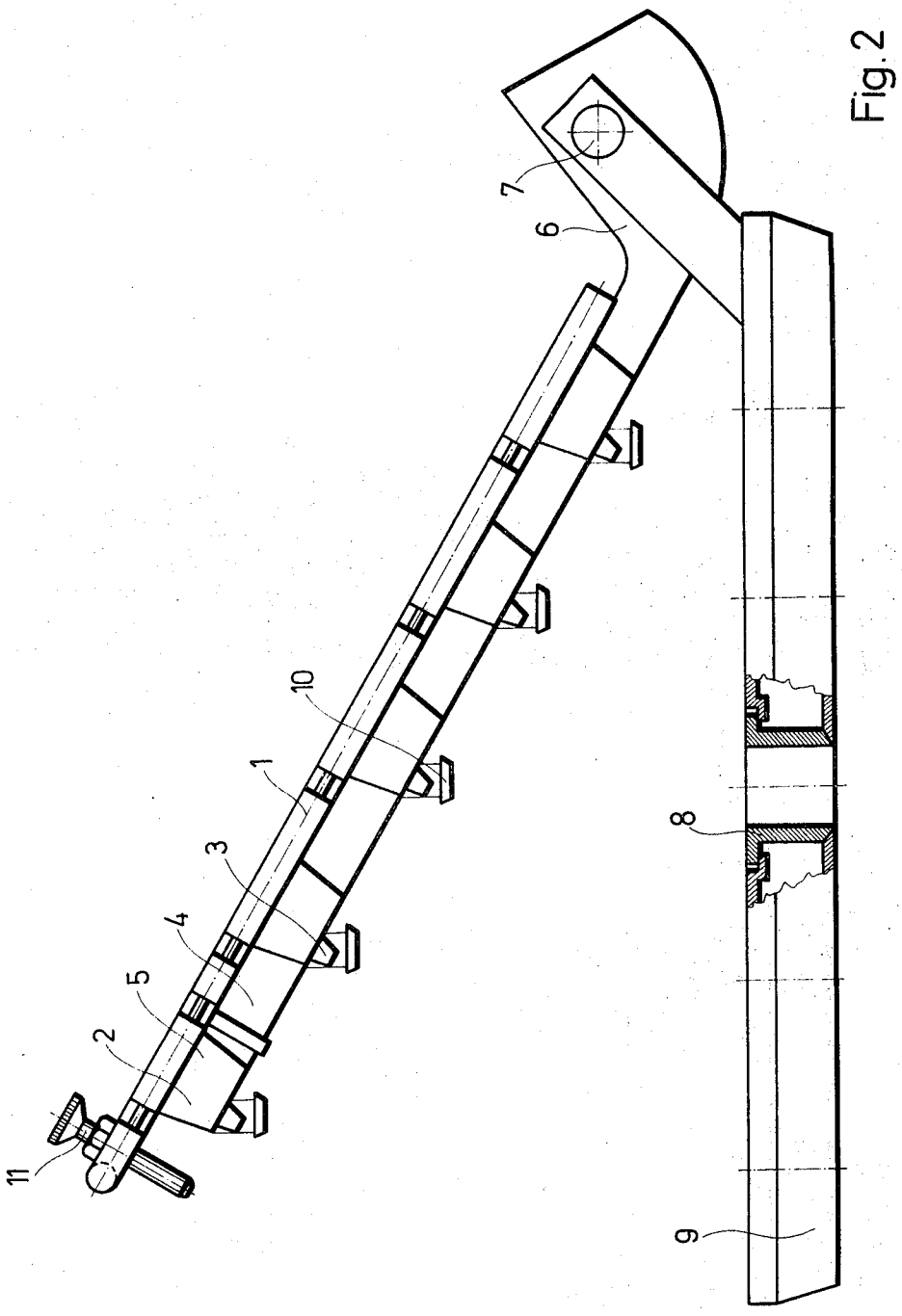


Fig. 2

CASTING APPARATUS WITH SLIDABLY MOUNTED BRANCH RUNNERS

The present invention relates to apparatus for casting aluminum ingots, more particularly of the type for simultaneously casting a plurality of identical aluminum ingots.

In the casting of aluminum ingots, it is desirable that all the ingots should be smooth and free of pipes or other discontinuities, and that the structure of the ingots should be fine grained and of uniform grain size over its entire cross section. Because of these quality requirements, it is difficult to achieve high output in casting, especially in the case of smaller ingots.

In this art, the trend has been to adjust casting capacity to furnace capacity so that the full charge can be cast at a single operation. However, furnace capacities are progressively increasing, and so the number of ingots which must be cast at the same time is increasing. For example, to cast a 10-ton meld in a single operation, 30 ingots of about 6 inch diameter must be cast simultaneously. For each ingot, the metal fed into the mold must be regulated and the level that the metal attains in the mold must be kept uniform through all the molds. At the same time, the quality of the casting must be maintained high as pointed out above. Accordingly, it is an object of the present invention to provide apparatus for simultaneously casting a plurality of aluminum ingots, in which the ingots produced have a smooth surface and uniform grain size.

It is also an object of the present invention to provide such apparatus that maintains identical metal levels in all the molds.

As indicated above, a problem in this art is the maintenance of desirable surface and grain structure characteristics of the cast ingots. It has now been found that differences in the quality of simultaneously cast ingots have been mainly due to inadequate equipment for metal feeding and level regulation. Among the equipment previously used in this field, best results have been obtained by the use of submerged runners or feed pipes. A float is attached to the runner to regulate the metal level of the mold. The position of the float, and hence the method level, is thus to some extent determined by the position of the runner. In the prior art, the runner pipes in the mold are located at the ends of branch pipes which in turn are rigidly fixed to a central metal distribution container. Before casting, the central container is located on a mold stool that has multiple molds therein, and the spouts of all the runner pipes are at the same height in the molds. But if the position of the central container is wrong, or the shape of the pipes has been deformed due to thermal expansion or use, it becomes impossible to achieve the necessary metal levels to obtain smooth surfaces on some of the ingots. Such a danger is always present, as the metal distribution container and the branch pipes are in direct contact with the molten metal during casting and so undergo deformation due to thermal expansion.

In the prior art apparatus of this type, the runners may be made of cast iron with a thin coating of china clay that is heated by the molten aluminum at, say, 700°C. to a temperature of perhaps 500 to 600°C. The outside is cooled by air. Alternatively, the runners may be made of steel coated inside with a 5–15 mm. thick layer of heat insulation, in which case the steel attains a temperature of perhaps 300 to 400°C.

The coefficient of thermal expansion of cast iron and steel is 12×10^{-6} per °C. Thus, a runner section 1 meter long can elongate 4 to 5 mm. when warmed from room temperature to aluminum casting temperature.

Moreover, at the beginning of casting, there may be a 100°C. temperature difference between the lower section of the apparatus in contact with the molten metal and the upper section which is not in contact with it. The lower section thus expands more than the upper and the runner twists and so is deformed from its intended shape. As a result, the runners assume different heights and positions and their valving or cut-off surfaces become inclined from the horizontal.

It has been determined that in the case of submerged casting, that is, in which the runner extends below the intended liquid level in the mold, high ingot quality can be achieved only if the spout or runner is located in the center of the mold at a predetermined level and has a horizontal cut-off or valving surface. This is often not achieved with the prior art devices. The transverse plate of the float is always horizontal; but if the spout is deflected, then the margins of the opening are tilted and the cut-off action impeded. Too much metal flows through the spout and solidification of the surface of the metal is retarded.

As a result of uneven thermal expansion and resulting twisting and deformation, streses and elastic deformations are imparted to the apparatus. At, say, 300 to 500°C., the stresses are equalized by exceeding the limit of elastic deformation, whereupon the apparatus takes on a permanent set. Then, after cooling, the runner and spout do not return to their original form but remain distorted. These distorted runners and spouts have in the past been corrected by striking them with hammers or putting them in a press, but these methods harm the lining and yield only temporary results.

The apparatus of the present invention comprises a metal distribution system mounted for vertical swinging movement about a horizontal axis, and comprising a frame supported for pivotal movement on a horizontal axle, a main metal distribution runner carried by the frame, branch runners one individual to each mold, the branch runners being adjustably mounted on the frame for sliding movement relative to the main runner, metal regulating floats carried by the branch runners, and a molten metal storage container secured to and communicating with and swinging with the main runner but located adjacent the horizontal axis of vertical swinging movement.

Other objects, features and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a plan view of apparatus according to the present invention; and

FIG. 2 is a somewhat diagrammatic side elevational view, with parts broken away, of the apparatus of FIG. 1.

Referring now to the drawings in greater detail, there is shown apparatus according to the present invention, comprising a rigid open frame 1 of a metal such as invar having practically zero coefficient of thermal expansion. A plurality of branch runners 2 have each a metal feed or down pipe 3 that extends into the mold below the liquid level therein. A main runner 4 communicates with all of the branch runners 2, which latter are disposed at acute angles of say 70° to runner 4 and are

slidably interconnected with runner **4** so as to maintain unchanged the position of at least the pipe **3** relative to the mold despite thermal expansion of runner **4.** To accommodate this relative movement of runners **2** and **4,** the ends **5** of runners **2** are telescopically arranged with corresponding outlets on runner **4.**

The branch runners **2** are carried by the relatively expansion-free rigid frame **1,** through adjustable mountings **5***a*, so that the branch runners **2** maintain their predetermined position relative to the frame **1,** regardless of expansion of runner **4.**

At its end remote from the branch runners **2,** the main runner **4** communicates with a container **6** for molten metal. The frame **1,** main runner **4,** and container **6** are all mounted for vertical swinging movement about a horizontal axis, on axle **7** which is fixedly secured to the molds **8** which in turn are interconnected by the horizontal mold stool **9.** Container **6** is integral with main runner **4** and has an arcuate bottom wall that is coaxial with axle **7.** The floats carried by branch runners **2** and suspended below pipes **3** for regulating liquid level in the molds are shown at **10.** At **11** is shown a screw-threaded member that adjustably supports frame **1** at variable inclinations on and relative to mold stool **9.** For example, if the runner **4** is relatively long and the molten metal cools in it to a temperature more than 10°C. cooler at its end remote from container **6** than at its end adjacent container **6,** then it may be desirable to maintain a slightly lower metal level in the corresponding end molds remote from container **6.** This can be achieved by so adjusting the member **11** as to tilt the frame **1** up by a very small angle perhaps 15 to 30 minutes of arc.

In operation, with the parts positioned as in FIG. **2,** the container **6** receives the charge of molten aluminum and the frame **1** is then tilted down to substantially horizontal position, the member **11** resting on mold stool **9.** The molten metal passes through runner **4** into branch runners **2** and down through pipes **3** into the molds and fills the molds to the desired uniform level regulated by floats **10** that operate in the usual way. At the completion of casting, the frame is again swung up, whereupon all metal remaining in the main runner **4** and branch runners **2** flows back into the container **6.**

From a consideration of the foregoing disclosure, therefore, it will be evident that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustratedd in connection with a preferred embodiment, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

Having described our invention, we claim:

1. Apparatus for simultaneously casting a plurality of aluminum ingots, comprising an elongated series of ingot molds, a main runner that extends along said series of molds to supply aluminum to the molds, container means for supplying molten aluminum to the main runner, a frame supporting the main runner, means mounting the frame for vertical swinging movement about a horizontal axis, branch runners one individual to each mold, with each runner including a float valve and a down pipe located at a predetermined level in a mold, and means supporting the branch runners on the frame for movement relative to the main runner.

2. Apparatus as claimed in claim **1,** and means mounting one end of each branch runner telescopically with the main runner.

3. Apparatus as claimed in claim **2,** the container being integral and vertically swingable with the main runner.

4. Apparatus as claimed in claim **3,** the container having an arcuate bottom wall that is coaxial with said axis.

5. Apparatus as claimed in claim **1,** said frame having substantially zero coefficient of thermal expansion.

6. Apparatus as claimed in claim **1,** and means for adjusting the inclination of the frame relative to the mold in a lower position of the frame.

7. Apparatus as claimed in claim **1** wherein each of said down pipes includes a horizontal cut-off or valving surface and said float valve includes a transverse plate for contact therewith.

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