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METHOD OF MANUFACTURING EXTRUDED ARTICLES

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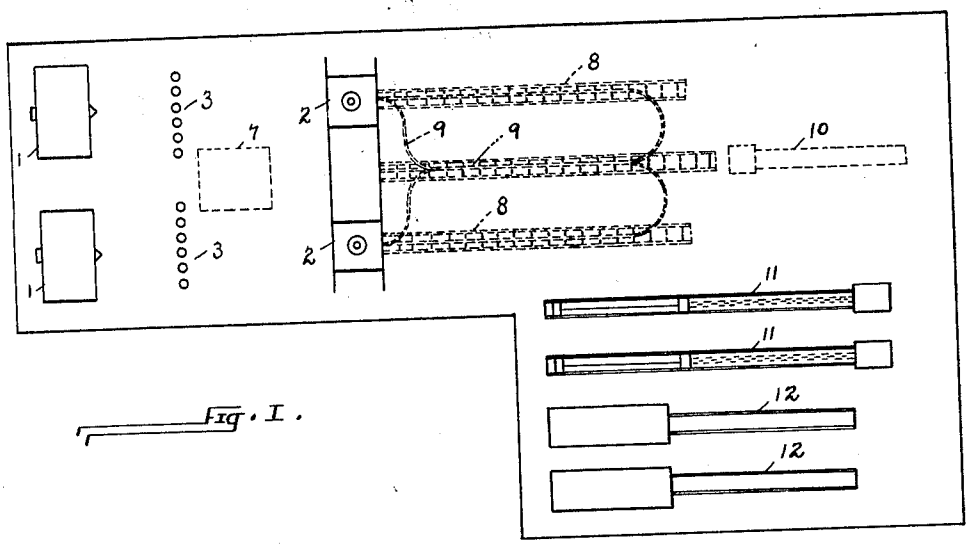


Fig. I.

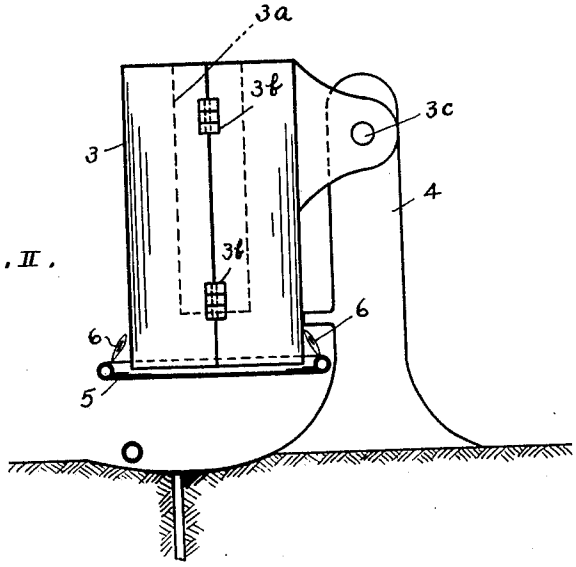


Fig. II.

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METHOD OF MANUFACTURING EXTRUDED ARTICLES

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4 Claims. (Cl. 207—10)

The invention relates to the extrusion of aluminum and aluminum alloys.

Aluminum (or aluminum alloy of the desired analysis) is cast into billets, and in extrusion presses the billets are extruded into elongate articles of the desired cross section. According to usual practice, a relatively great mass of molten aluminum is cast and solidified in billet molds, and usually the molds are water cooled, to accelerate the cooling and solidifying of the metal. Upon removal from the molds, the cold billets are stored away, and from time to time such billets as are required to keep the extrusion presses in operation are removed from storage and heated to proper extruding temperature. It is characteristic of this practice that the billets are chilled or cooled far below extrusion temperature before removal from the molds, and tend to become piped at their centers. The metal is coarse, and is found to be porous and crystalline at surfaces of the billets. In consequence large crystal markings appear in the surfaces of the extruded articles. In the case of aluminum alloys including copper, magnesium, manganese, and other alloying substances, we find that the sudden chilling of the billets tends to freeze out the alloying materials. For example, the magnesium and manganese precipitate and concentrate at the surfaces of the billets, while the copper concentrates in the lower body portions of the billets. When such billets are placed in a heating furnace, the concentrated alloying metals sweat or bleed through the surface pores of the billets, and are quickly burned or oxidized. The objections are manifest.

Still other objections exist. The surfaces of the billets in storage oxidize in relatively short time, and their surface pores accumulate dust and particles of abrasive which cannot be removed in practical way. Various coating materials have been tried on the billets without satisfaction. The hard oxide surfaces of the billets and the included dust particles scratch the extruding dies of the presses, and appear in the finished article to spoil the desired surface finish.

As distinguished from such practice, the method of this invention consists in casting the molten aluminum in heated molds. The temperature of the metal in the molds is allowed to fall until the metal congeals, but the falling temperature is arrested at approximately 950° F.—the temperature at which extrusion operation is conducted. The billets are removed from the molds at extrusion temperature and immediately introduced to the extruding presses. By virtue of this particular refinement in procedure, many advantages are realized.

1. The tendency for the alloying ingredients of the metal to precipitate in the surfaces of the billets is effectively restrained.

2. The tendency for coarse grain structure and large crystals to appear in the billet surfaces is inhibited.

3. The occlusion of oxygen and the formation of metal oxides in the surfaces are reduced to a minimum.

4. It follows upon the above advantages that the wear on the extrusion dies is reduced, and the product is superior both in surface finish and in internal structure.

5. And the usual practice of storing billets is eliminated, and the costly practice of reheating cold billets is dispensed with.

In the accompanying drawing Fig. I is a diagrammatic view or floor plan of apparatus for the practice of the invention; and Fig. II is a view, partly in side elevation and partly in vertical section, of one of the billet molds of the apparatus.

Referring to Fig. I of the drawing, the reference numeral 1 is applied to a battery of furnaces, in this case two. An extrusion press 2 is installed in line with each furnace, and a battery of billet molds 3 is provided for each furnace, between the furnace and its associated press 2.

In accordance with the invention, stock aluminum is weighed and charged into the furnaces 1, and the desired alloying metals are added in the usual way. Following known procedure the metal is melted and stirred, skimmed, and brought to proper consistency and temperature for pouring. Then, by means of the usual pouring pots or siphons (not shown), the metal is teemed into the billet molds 3.

The molds are preheated to such degree, or heat is applied at such intensity to the molds during, or immediately after, casting, that the cooling of the cast metal is arrested at approximately 950° F., that is, at the proper temperature for extruding. This critical temperature may, of course, vary for aluminum alloys of different compositions. By such utilization of heat —heat additional to the heat inherent in the cast metal—the rate of cooling of the billets is retarded and graduated. The cooling gradient from the center of each billet outward more nearly approaches the ideal, and the metal tends to congeal more uniformly throughout the body

of the billet. In such manner advantages of the nature indicated are obtained.

The billets are held at extruding temperature in the heated molds, until, so far as possible, homogeneity of structure and uniformity of temperature are established throughout the bodies of the billets. Thus, the well-known advantages of the soaking pit in steel mill practice are obtained in the aluminum mill, it being understood that the tendency for the surface of a heated aluminum billet to crystallize and adsorb oxygen from the air has caused aluminum manufacturers to leave the billets in the molds until they are relatively cool. For this reason the aluminum art has employed closed reheating furnaces, rather than soaking pits.

Upon removal from the molds, the billets are introduced immediately to the extrusion cylinders of the presses **2**, and in known manner are extruded into the desired elongate shapes. A small ladle of molten aluminum is poured into each extrusion cylinder before a new billet is inserted, whereby the leading end of the new billet is fused and welded to the stub remaining in the cylinder from the next preceding billet. Thus, the extruding operation is in effect continuous, that is, an extruded article of desired continuity and length may be produced. In some cases a heating furnace **7** (Fig. I) is installed between the billet molds and the presses, whereby, if there be a break-down of one press, or if for some other reason the supply of billets at extruding temperature exceeds the capacity of the presses, the surplus billets may be introduced to the furnace **7** and held substantially at the temperature at which they leave the molds.

In Fig. II a billet mold of suitable structure is illustrated in detail. It consists in a two-part mold body **3** of cast iron or steel, having its billet-forming cavity **3***a* extending vertically. The plane of parting extends vertically on the axis of cavity **3***a*. The two halves of the mold are hinged together on one side, as indicated at **3***b*, and a suitable fastener (not shown) is arranged on the opposite side, whereby the halves may be locked together for the casting of a billet, and, alternately, may be released, to swing open for removing such billet. In further refinement, the mold is pivotally mounted, at **3***c*, on a pedestal **4**, in such manner that the mold may be swung bodily into horizontal position before the halves are swung open. It has been found that the application of heat is particularly effective at the lower body portion of the mold, and, in this case, a circular gas-burner **5** is arranged to play burning jets **6** against the peripheral side wall of the mold. It may be noted that neither the support nor the air and gas mixing inlet for the burner is illustrated in the drawing; the provision of such things is a matter of common engineering practice, requiring no special consideration in this specification.

The presses **2** advantageously are tower presses, adapted to extrude the metal in vertical direction through the floor on which the presses are mounted, and beneath such floor, work-receiving tables **8** and rail conveyors **9** are arranged in the manner illustrated and described in our co-pending applications Serial No. 130,568 and No. 130,569, both filed March 12, 1937. If required, the extruded articles may be cut to specified length on a shearing table **10**, and in known way the sheared lengths may be processed first in draw-benches **11** and then annealing furnaces **12**.

The above-described method will prove valuable in preparing aluminum billets, or other workpieces, for final shaping in machines other than extruding presses and at working temperatures other than extruding temperature.

We claim as our invention:

1. The herein described method which includes reducing an aluminum base metal to homogeneous fluid state, casting the metal in billet-forming molds, cooling and solidifying the metal in such molds, arresting such cooling of the metal at approximately extruding temperature, and removing the billets from the molds at such temperature and extruding them into desired shape.

2. The method of manufacturing extruded articles of aluminum base metal which includes reducing the metal to fluid state, casting such metal in preheated molds to the form of billets, cooling the cast metal to approximately extruding temperature, holding the billets approximately at such temperature for a substantial interval of time, and then extruding them to form said articles.

3. The method of manufacturing articles of aluminum base metal which includes reducing the metal to fluid state, casting and cooling such metal in billet-forming molds, and, by application of heat to the molds, arresting the cooling and holding the cast metal at approximately metal-working temperature, removing the billets from the molds at approximately such temperature, and forming them into said articles.

4. The herein described method which includes reducing an aluminum base metal to homogeneous liquid state, casting the metal into hot billet-forming molds, cooling the billets in such molds to approximately extruding temperature and then removing the billets and introducing them to a press at substantially the temperature at which they were removed from the molds and shaping the billets in such press into the desired articles.

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