Nov. 14, 1967 B. L. HARPER ET AL 3,352,648

SELF-PALLETIZING, INTERLOCKING, COPPER INGOT

Filed Jan. 29, 1965

FIG. 1.

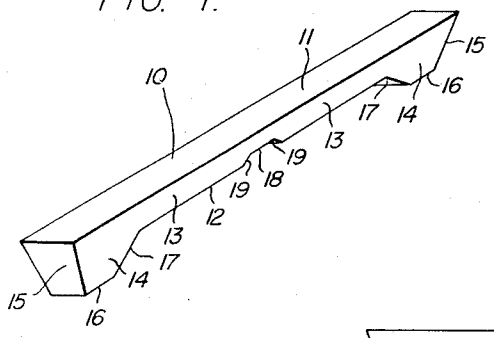



FIG. 3.

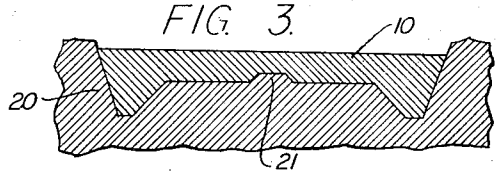



FIG. 4.

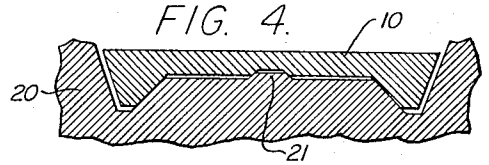



FIG. 2.

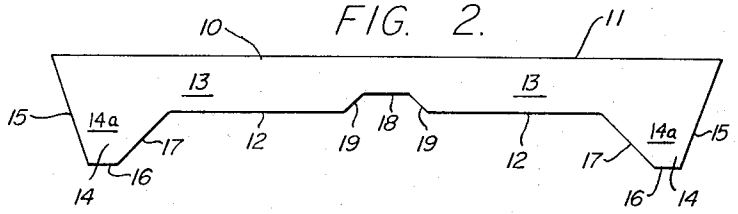



FIG. 5.

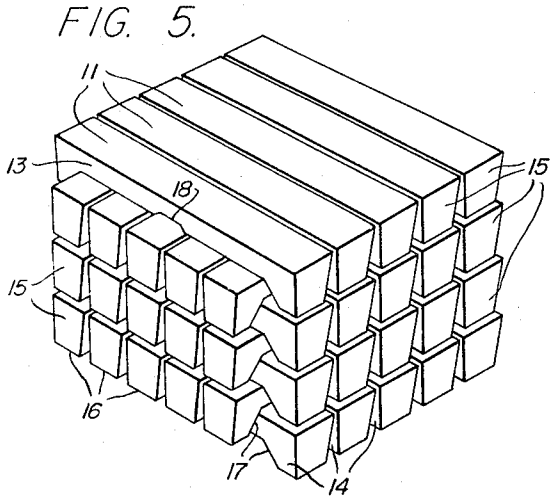



FIG. 7.

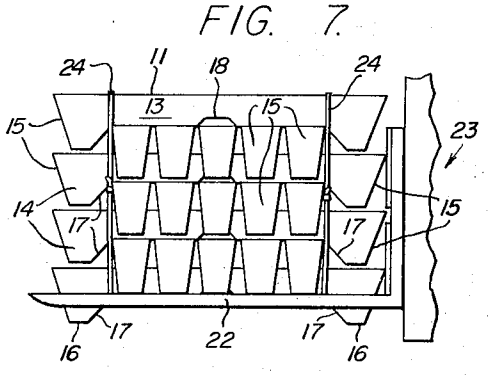
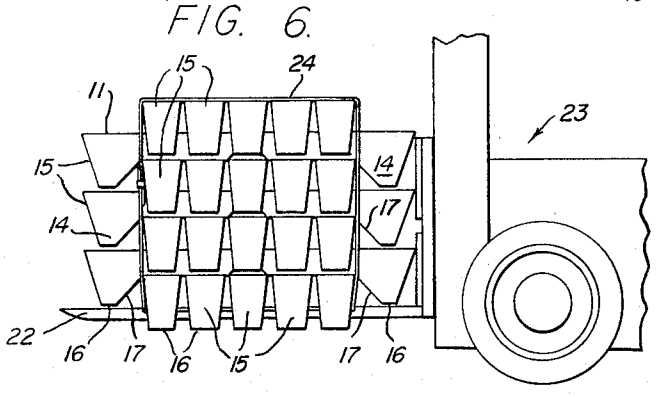



FIG. 6.




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# SELF-PALLETIZING, INTERLOCKING, COPPER INGOT

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## ABSTRACT OF THE DISCLOSURE

A metal ingot and self-palletized stack of same as articles of manufacture facilitating transfer of crude copper, or example, from smelter to refinery. A special configuration for the ingot reduces splashing of molten metal during molding, aids its removal from the mold, makes for unusual lightness in weight, enables it to be easily broken in two, facilitates positional orientation on a conveyor, and enables self-palletized stacking.

This invention relates to metal ingots as products of manufacture and is particularly concerned with copper ingots produced by copper smelters for transportation to market or to electrolytic refineries. For handling and storage, it is customary to stack a number of the ingots together and tie them as a bundle, the resulting bundles being handled as individual units.

It is the purpose of the invention to provide an ingot of such configuration as to be easily stacked, manually or by machine, to form square, stable stacks for bundling and for being picked up and moved individually by a conventional fork lift from any one of its four sides, without the need of the usual pallets.

Other purposes are to provide or reduction of splash in the molding of the ingots and for easy removal of the ingots and for easy removal of the ingots from the molds following cooling, and to provide a lighter-weight ingot and one that can be quickly and easily broken in two for some uses.

In the accomplishment of these purposes, an outstanding feature of the invention is the provision of an elongate body portion having a pair of leg portions at its opposite ends, the side surfaces of the ingot converging smoothly from the top of the body portion to the bottom, i.e. feet surfaces, of the leg portions. To minimize splash in the molds, such molds are formed with a raised central portion which results in a notch centrally of the body portion. This notch both lightens the ingot and enables it to be broken in two easily.

Moreover, the sloping sides and the extended legs of the ingot enable it to properly orient itself on a conveyor. Its simple configuration results in both the ingot pushing itself out of its mold as it shrinks during cooling and in the ingot falling freely from the mold when dumped.

There is shown in the accompanying drawing a specific embodiment of the invention representing what is presently regarded as the best mode of carrying out the generic concepts in actual practice. From the detailed description of this presently preferred form of the invention, other more specific objects and features will become apparent.

In the drawing:

FIG. 1 is a perspective view showing a copper ingot conforming to the invention;

FIG. 2, a side elevation;



FIG. 3, a fragmentary, longitudinal, vertical section through a mold for producing the ingot of the foregoing figures, the view being taken just after pouring and before cooling of the molten copper;

FIG. 4, a view corresponding to FIG. 3, but taken after cooling of the molten copper;

FIG. 5, a perspective view of a number of the ingots of FIGS. 1 and 2, showing how they are stacked for bundling;

FIG. 6, a view in side elevation of the stacked and bundled ingots of FIG. 5 being picked up by a conventional fork lift; and

FIG. 7, a similar view of the bundle being picked up from a different side.

Referring now to the drawing:

The copper ingot shown per se in FIGS. 1 and 2 includes an elongate body portion **10**, having flat top and bottom surfaces **11** and **12**, respectively, and a pair of flat side walls **13** that converge from the top surface to the bottom surface.

Formed integrally with such body portion and extending from the bottom thereof at opposite ends thereof are legs **14**, whose side walls **14***a* are flat and form smooth continuations of the respective side walls **13** of body portion **10**.

The end surfaces **15** of the ingot are flat and inwardly inclined from the top surface **11** of the body portion downwardly to flat, feet surfaces **16** formed at the bottoms of the respective legs **14**, and flat, confronting, leg surfaces **17** diverge downwardly from opposite ends of the bottom surface **12** of the body portion **10** to the respective feet surfaces **16**. Legs **14** extend downwardly from the elongate body portion a distance substantially equal to the thickness of such body portion between the top surface **11** and the bottom surface **12** thereof.

A notch **18**, preferably elongate with downwardly and outwardly sloping ends **19**, is formed in the bottom of body portion **10** midway between the legs **14** and preferably across the entire width of bottom surface **12**.

The ingot is formed by pouring molten copper into a mold, shown fragmentarily at **20**, FIG. 3. A central, upstanding protrusion **21** within the mold forms the notch **18** in the ingot, and, as the molten metal is poured into the center of the mold, protrusion **21** divides the flow stream to reduce the splash that would otherwise occur as the molten metal fills the mold.

As the metal cools and the ingot hardens, it shrinks toward its center, as shown in FIG. 4. This results in the sloped interior walls **17** and end walls **19** squeezing against the corresponding sloped walls of the mold to force the ingot from the mold. It has been found that where the interior flat surfaces **17** and the flat walls **19** form approximately 45° angles with respect to the flat bottom surfaces **12**, cooling of the ingot will push the ingot out of the mold a maximum distance.

It has also been found through experimentation that, when end surfaces **15** each form an angle of approximately 70° with the top surface **11**, the ingot will pivot and fall freely from the mold **20** when the mold is dumped.

An ingot wherein the top surface **11** is twenty-five inches in length and three inches in width, the bottom surface **12** is fifteen and a half inches in length and two and a half inches in width, and each foot is two inches in width has proven highly advantageous, since ingots having these dimensions are readily stacked into square, stable bundles twenty-five inches on a side that are con-

veniently arranged four abreast in the standard eight foot six inches wide box car, and that require little, if any, dunnage. In this connection, it should be noted that the area of the feet surfaces **16** at the bottoms of legs **14** must be maintained sufficiently large that, when the weight of an entire bundle is distributed through the feet of the ingots forming the bottom row of the bundle, the load is not so great at any given point that the floor of the boxcar will give way.

It has also been found that if the body portion **10** has a thickness (i.e. the distance between its top and bottom surfaces) of two inches throughout the greater part of its length, the ingot will not warp during cooling. The thickness can be less than two inches for a small portion of the overall length, however, such as at notch **18**.

The size of the notch can be used to control the weight of the ingot. For example, an ideal specified weight for a copper ingot is fifty pounds. Without the notch, an ingot configurated in accordance with the invention and having a two-inch thick main body portion, widths as specified, an overall length of twenty-five inches and at least fifteen and a half inches between the legs, so that five ingots can be positioned therebetween during stacking, will have an average weight of 55 pounds. By use of the notch, this weight will be cut and the completed ingot will have an average weight of 53 pounds.

The notch also provides a convenient center mark for the ingot, and some users, especially those employing batch-feed brass furnaces, "cut" the ingot in half merely by hitting the top surface **11** with a sledge hammer at the point opposite the notch. Because the ingot is weakened at that point, it breaks to form two sections of approximately equal weight.

In stacking the ingots to provide a bundle for storage or shipping, a bottom row is formed by placing the individual ingots in side-by-side relationship, with their feet down. The number of ingots making up the row is determined by the distance between the legs of each bar and by the number of ingots that will fit therebetween. With the ingots above-described, each having an average weight of 53 pounds, five of them will fit between the legs of each one above and this number will be used to form the bottom row. This means, of course, that the weight of the stack will then be distributed through the ten legs on the ingots making up the bottom row.

A second row of ingots is placed on top of and normal to the bottom row, with their legs straddling the ingots of the first row and their feet down. A third row is similarly positioned on the second row, etc.

Since legs **14** extend downwardly from the body portion **10** a distance equal to the thickness of the body portion, they do not obstruct passage of a tine **22** of a standard fork lift, see FIG. 6, beneath the body portions of the several ingots making up the bottom row in picking up the stack from either one of two mutually opposite faces thereof, and, when the fork lift raises the stack, the bottom row acts as a pallet. The overhanging legs **14** of each ingot prevent lateral slippage, and the flat top and bottom surfaces of the body portion **10** insure a stable stack.

The tines of the fork-lift can also be used to straddle the several ingots making up the bottom row, see FIG. 7, and to pass beneath the feet **16** of the ingots making up the second or next to the bottom row where it is desired to pick-up a bundle stack from either one of the two other mutually opposite sides. In this instance, when the tines are raised to lift the stack, the second row acts as the pallet and the bottom row must be tied to the remainder of the stack, for example, with metal bands **24** that pass beneath the main body portions of the ingots of the bottom row and over the ingots making up the top row to form a bundle of the stack. In practice, it is preferred to bundle all of the stacks in this manner so they can be picked-up from any one of the four sides as may be found most convenient in the bundling operations.

The simple configuration of and the uniform weight obtainable for the ingot makes it easily handled by conventional ingot-stacking machines, such as are presently used in handling aluminum ingots. Furthermore, should the ingots be dumped on their sides on a conveyor belt leading to the stacking machine, the inclined side surfaces thereof and the extending legs will roll the ingot into a position wherein the legs straddle the conveyor belt and the flat bottom surface of the ingot rests on the belt. The ingots are thus properly aligned to be handled by the stacking machine.

Whereas there is here illustrated and specifically described a certain preferred embodiment of the invention which is presently regarded as the best mode of carrying it out in actual commercial practice, it should be understood that various changes may be made and other constructions adopted without departing from the inventive subject matter particularly pointed out and claimed herebelow.

We claim:

**1.** A self-palletizing, interlocking ingot, comprising an elongate body portion, having flat top and bottom surfaces and mutually opposite flat, side surfaces interconnecting said top and bottom surfaces and converging from the top surface to the bottom surface; a pair of legs formed integrally with said body portion at opposite ends thereof and having flat feet surfaces, respectively; flat end surfaces extending and inwardly inclined from the said top surface to the respective feet surfaces; flat, confronting, leg surfaces diverging downwardly from opposite ends of the bottom surface to the respective feet surfaces; and mutually opposite, flat, side surfaces for each of said legs, these side surfaces converging downwardly to the respective feet surfaces and forming, with the said side surfaces of the body portion, respective, flat, continuous surfaces.

**2.** A self-palletizing, interlocking ingot according to claim **1**, wherein the thickness of the body portion between the top and bottom surfaces is substantially the same as the distance between the bottom surface and the feet surfaces of the legs.

**3.** A self-palletizing, interlocking ingot according to claim **2**, further including a central notch in the bottom surface of the body portion, between the confronting leg surfaces.

**4.** A self-palletizing, interlocking ingot according to claim **3**, wherein the notch extends across the width of the bottom surface of the body portion and is elongate, with downwardly and outwardly sloping ends.

**5.** A self-palletizing, interlocking ingot according to claim **3**, wherein the end surfaces form respective angles of about seventy degrees with the top surface of the body portion, and the confronting leg surfaces form respective angles of about forty-five degrees with the bottom surface of the body portion.

**6.** A self-palletizing, interlocking ingot according to claim **5**, wherein the length of the surface is about twenty-five inches, the length of the bottom surface is about fifteen and one half inches, the width of the top surface is about three inches, the width of the bottom surface is about two and one-half inches, and the width of each of the feet surfaces is about two inches.

**7.** A self-palletized, square stack of interlocked copper ingots adapted to be picked up from any one of its four sides and moved by a conventional fork-lift, comprising a plurality of individual copper surfaces and mutually opposite, flat, side surfaces interconnecting said top and bottom surfaces and converging from the top surface to the bottom surface; a pair of legs formed integrally with said body portion at opposite ends thereof and having flat feet surfaces, respectively; flat end surfaces extending and inwardly inclined from the said top surface to the respective feet surfaces; flat, confronting, leg surfaces diverging downwardly from opposite ends of the bottom surface to the respective feet surfaces; and mutually opposite, flat, side surfaces for each of said legs, these side surfaces converging downwardly to the respective feet

surfaces and forming, with the said side surfaces of the body portion, respective, flat, continuous surfaces, there being a bottom row of said ingots in side by side relationship; a second row of ingots in side by side relationship having their flat bottom surfaces resting on the top surfaces of said bottom row of ingots and their legs straddling said bottom row; and additional rows of ingots, each row having the bottom surfaces of the ingots therein resting on the top surfaces of the ingots of the row below and the legs of the ingots therein straddling the ingots of the row below.



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