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EXTRUSION MILL

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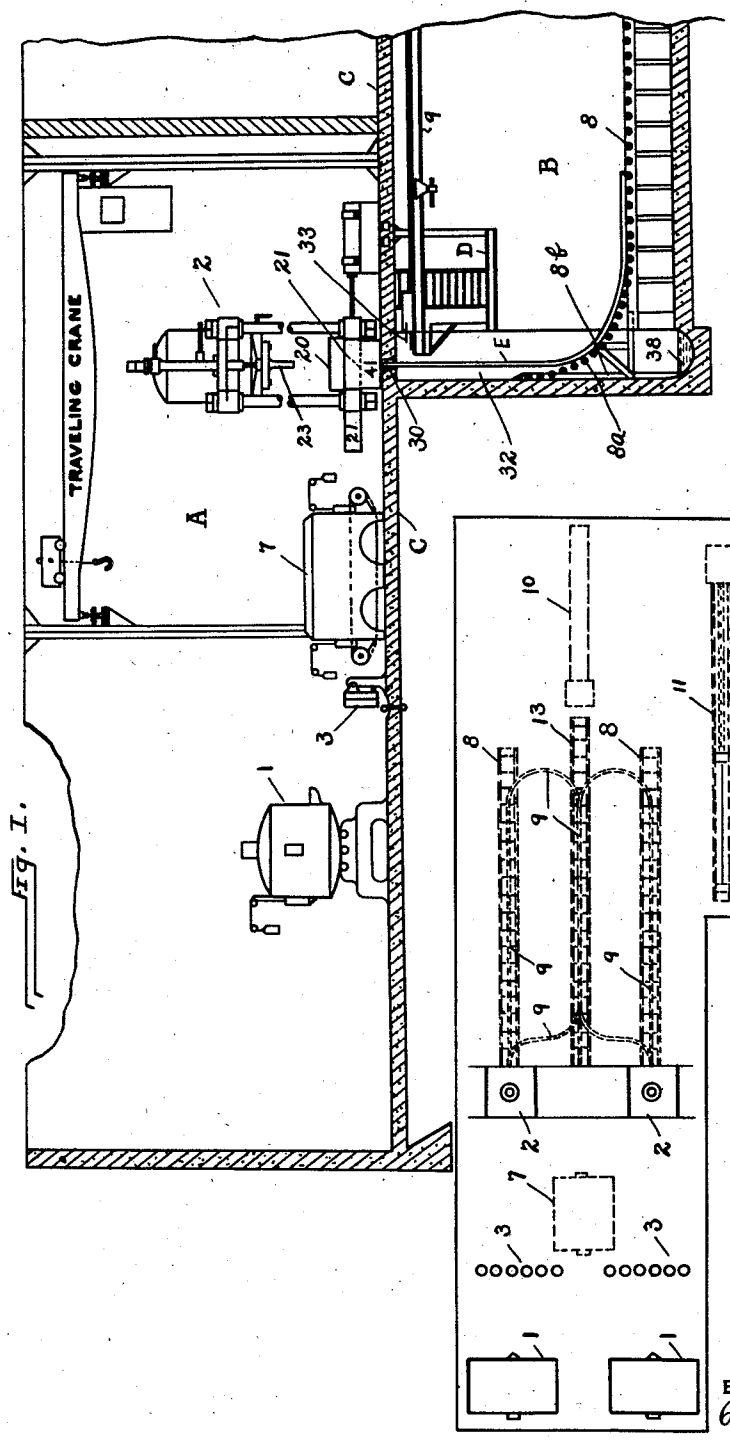


Fig. I.

Fig. II.

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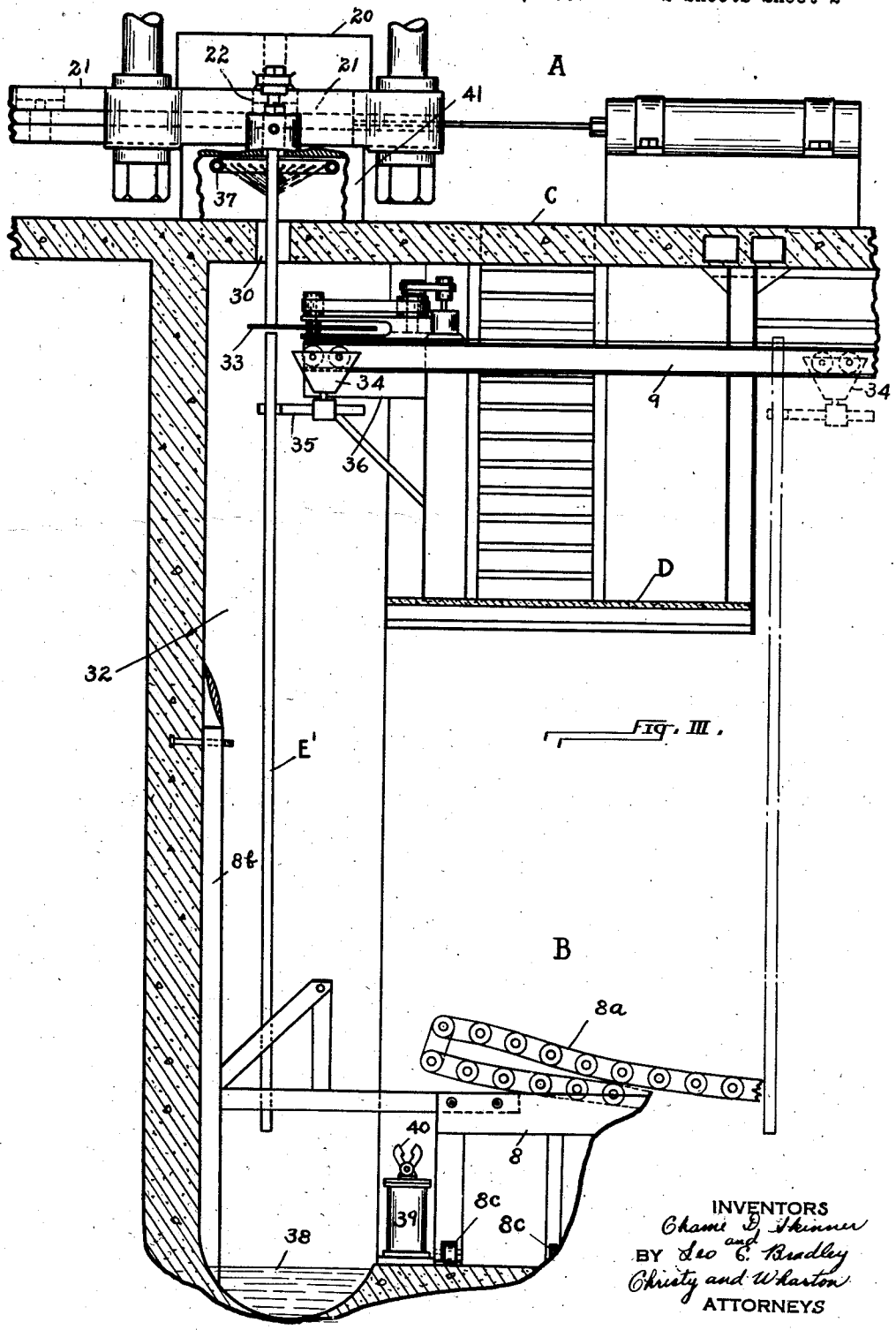


Fig. III.

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EXTRUSION MILL

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Application March 12, 1937, Serial No. 130,569

8 Claims. (Cl. 207—1)

Our invention relates to the manufacture of extruded articles, and particularly to the manufacture of tubing, bars, and other elongate articles, either hollow or solid, of extruded aluminum. The invention consists in particularly effective organization of apparatus in an extrusion mill for the working of stock metal into finished product, especially in the arrangement of an extrusion press with apparatus for handling and refining the extruded articles leaving the press, and in method.

Our objects are to reduce the size and cost of an extrusion mill of given capacity; to minimize the cost of handling material within the mill; to economize in labor; to reduce scrap loss; and to produce superior product.

An extrusion mill embodying the invention is illustrated in the accompanying drawings. Fig. I is a fragmentary view of the mill in vertical section; Fig. II is a diagrammatic floor plan of the mill; and Fig. III is a fragmentary view on the plane of section of Fig. I, showing particular portions of the mill to larger scale.

Referring to the drawings, we provide a mill having upper and lower working stages A and B, separated by a horizontal floor or platform C. One or more tower presses 2 are installed in the upper stage, and in accordance with known practice each press includes an extrusion cylinder 20 secured upon a bed or platen 41 that embodies extrusion dies 22 in a locking plate or stripper 21 (Fig. III). Billets of aluminum (or of other metal to be extruded) are introduced to the extrusion cylinder one after another and at extrusion temperature; in known way the vertically reciprocable plunger 23 of the press (Fig. I) is caused powerfully to descend into the extrusion cylinder, whereby the metal of the billets is forced through the extruding dies 22, forming an elongate article E. The cross section of the extruded article conforms to the bore (the throat and bearing) of the particular die employed in the press.

In this case the billets for introduction to the press or presses 2 are cast and prepared for extrusion in the upper stage A. As disclosed in our co-pending application Serial No. 81,428, filed May 23, 1936, we provide a furnace 1 in line with each press 2, note Fig. II. Stock aluminum is weighed and charged into the furnaces 1, and the desired alloying metals are added in 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 billet molds 3.

The molds are preheated to such degree, or heat is applied at such intensity to 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, be varied for aluminum alloys of different compositions. By such utilization of heat—heat applied to the molds—the rate of cooling of the billets is retarded and graduated.

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. Upon removal from the molds, the billets are introduced immediately to the extrusion cylinders 20 of the presses 2, and in known manner are extruded into the desired elongate shapes E. A small ladle of molten aluminum is poured into each extrusion cylinder before a new billet is inserted, whereby the leading end of such new billet is fused and welded to the stub remaining in the cylinder from the billet last extruded. Thus, the extruding operation is in effect continuous, that is, an extruded article of desired continuity may be produced. In some cases a heating furnace 7 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 accordance with the present invention, the lower working stage B includes a vertical work-receiving chamber 32. The vertically extruded article E is fed in vertical, rectilinear course from the upper working stage to the lower, through a passage 30 in the floor C. Means are provided in such lower stage for receiving the work, and, in this case, we provide on the floor of the lower stage and beneath each press a roller table 8. The work-receiving face of each table 8 includes a curved reach 8a that extends upward from and beyond the end of the table, and the outer or upper end of such reach is secured to a frame 8b, as indicated diagrammatically in Fig. I. The extruded material E, fed downward through the platen 41, passage 30, and vertical work-receiving chamber 32, moves in continuous length first over the curved extension 8a and then upon the table 8. As shown in the

drawings, the vertical pass from the extruding die to the conveyor table is of relatively great extent, and in it the work moves freely in rectilinear course, there being neither guiding blocks nor work-enclosing walls against which the surface of the extruded article may slide and become marred. The several tables **8** arranged beneath the extrusion presses may each be of such longitudinal dimension as to receive and support a continuously extruded article of desired length. Adjacent each work-receiving table **8**, or between the two work-receiving tables of the two extrusion presses **2** shown in Fig. II, we organize a horizontal stretching table **13**, a known piece of apparatus, employed in aluminum mills for stretching the extruded work lengthwise, to remove twists and other irregularities. If specifications require it, the material is next cut into lengths on a shearing table **10** (Fig. II), aligned with the stretching table, and then the sheared pieces are put through one or more draw-benches **11** and annealing furnaces **12**. The shearing table, draw-benches, and annealing furnaces are known apparatuses commonly employed in the treatment of extruded metal, and detailed consideration of them is unnecessary to an understanding of our invention; suffice it to say that such apparatuses are, conveniently, arranged with the work-receiving tables **8** in the lower working stage B.

In the manufacture of certain shapes, it is desirable that the extruded article leaving the press shall not be bent or curved, in the manner that the product E is curved, as it is fed over the roller support **8***a* and upon table **8**. Advantageously, we provide a rail conveyor system **9** in the lower working stage B of our mill, and immediately beneath the passage **30** we arrange a mechanically driven saw **33**, mounted for reciprocation in horizontal plane, note Fig. III. The extruded article E′ is fed in vertical and straight course downward into the extrusion chamber **32**, it being noted that the roller extension **8***a* is detached from frame **8***b* and swung aside. Indeed, the table **8** itself is mounted on wheels **8***c*, so that it may be laterally shifted from aligned position beneath the portion of rail **9** shown in Fig. III.

Trolley-members **34** are mounted for travel on the rail conveyor system (**9**), and each trolley-member carries a clamp **35**. Between the upper and lower working stages A and B, a workman's platform D is provided. In service, the operation of the extrusion press is momentarily arrested when the lower end of the vertically extruded article E′ approaches the bottom of the extrusion chamber **32**, and the workman on platform D secures the clamp **35** of a trolley-member to the arrested article, as shown in Fig. III. Then, he shifts the power saw **33** from right to left upon its supporting base **36** and into the position shown in Fig. III, whereby the article E′ is severed on a plane lying immediately below the passage **30**. The detached length of the article hangs vertically from the trolley-member **34**, and in such position it is transported to the horizontal stretching apparatus **13**. Immediately upon removal of the sheared article from vertical extrusion chamber **32**, the saw is shifted from position beneath the work, and the extruding operation started again.

In the usual practice of extruding aluminum in horizontal direction the work passes to a work-receiving table immediately upon passing from the extrusion die. There is a marked tendency in such case for the hot extruded metal to become distorted and marred. These objections are eliminated (or minimized) in our practice, it being noted that during the extrusion in vertical direction nothing touches the work from the time it leaves the die and until the extruding operation is arrested for the shearing and clamping steps alluded to. The extruded metal is subjected to tension produced by its own weight, first during extruding and then while vertically supported by clamp **35**. That is to say, the hot extruded metal is allowed to cool under tension; and at the end of the same line in vertical position.

In extruding aluminum, the hot metal passing from the extruding die into the atmosphere tends to oxidize at its surface. Additionally, the alloying metals in the aluminum tend to precipitate at the surface of the extruded article and to oxidize more rapidly than the aluminum itself. The use of a water-spray upon the extruded work is known to be beneficial; it chills the metal in such manner as to prevent the precipitation of the included alloys, and to inhibit surface oxidation. It will be understood that the extruding dies must not be unduly chilled, for the aluminum will freeze in such manner as to rupture the dies and make extrusion impossible. Thus, in a horizontal press a water-spray cannot be organized in such close proximity to the die as to achieve the most beneficial results.

In accordance with our invention, we arrange a water-spraying device **37** (Fig. III) immediately below the extrusion die **22**; the water-spraying device is arranged above the saw **33** (or other shearing means employed) and above the work-receiving or conveying means **8** and **9**. No sooner does the extruded aluminum leave the extrusion die and pass into the open air beneath than it is subjected to the chilling and heat-treating effect of the spray. The water (or other liquid) applied to the vertically extending extruded article runs downward, forming a protecting film on the surface of the work, and inhibiting precipitation of the alloys in the metal. Upon flowing to the lower end of the work, the liquid enters a reservoir **38** provided at the base of the extrusion chamber **32**. In keeping with economy, the liquid may be recirculated from the reservoir **38** to the spraying device **37**.

By virtue of such apparatus we gain the desired ends, and insure that no water shall reach the extrusion dies, as it frequently does in horizontal presses. Danger of die breakage is minimized.

In still further refinement of present practice, we advantageously stretch the extruded articles (E′) in vertical rather than in horizontal position. And to this end we secure upon the floor of the working stage B a power cylinder **39**, whose vertically reciprocable plunger carries a pair of clamping jaws **40**. Subject to the control of suitable valves (not shown), compressed air (or water under pressure) is adapted to effect the vertical reciprocation of the plunger. In practice, each extruded piece E′ is by a trolley-member **34** carried to a position above the cylinder **39**, and the jaws **40** are powerfully elevated and secured to the lower end of the piece, while the upper end thereof is firmly secured in the clamp **35** (or other suitable work-engaging means) carried by the trolley-member. Then, the plunger of cylinder **39** is caused powerfully to descend, and the extruded piece is stretched in the desired manner. Then, the jaws **40** are

opened, and the piece is transported on the rail conveyor 9 to the shearing table 10 or other apparatus for treating the product.

It will be understood that within the terms and intent of the appended claims various modifications and elaborations will be evident to the engineer. And we may remark that in our copending application Serial No. 130,568, filed March 12, 1937, particular refinements in extrusion press structure per se are disclosed.

We claim as our invention:

1. An extrusion mill including an upper working stage and a lower, said upper stage including means for extruding an elongate article and feeding the extruded article to said lower stage, a conveyor including means for engaging the upper end of an extruded article, and transporting such article depending therefrom in vertical direction, and means for securing the lower end of said vertically extending article and cooperating with said conveyor in stretching the article.

2. An extrusion mill including a vertical press for extruding an elongate article in vertical direction, a conveyor adapted to receive the extruded article, said conveyor including means for engaging the upper end of said article, whereby to support the article vertically depending therefrom, and means for securing the lower end of the supported article and cooperating with said first-mentioned means in stretching the article.

3. An extrusion mill including means for extruding an elongate article in vertical direction, means for shearing the extruded article in vertical lengths, means for engaging the upper ends of the extruded and sheared articles, means for engaging the lower ends of such articles, and means for effecting relative movement of said engaging means in vertical direction, to stretch and true the bodies of said articles.

4. In the vertical extrusion of metal into the form of an elongate article, the herein described method which comprises delivering the gradually extruded metal, hanging freely from the extruding die, through an elongate vertical pass, and, by subjecting the gradually extruded metal leaving the mouth of the die to tension produced by the weight of the metal hanging freely below, inhibiting distortion in the extruded article.

5. In the vertical extrusion of metal into the form of an elongate article, the herein described method which comprises delivering the gradually extruded metal, hanging freely from the extruding die, through an elongate vertical pass, and, by subjecting the gradually extruded metal leaving the mouth of the die to tension produced by the weight of the metal hanging freely below, inhibiting distortion in the extruded article, and, when the extruded article reaches desired length and while it is suspended in vertical position, transversely severing the extruded metal below the mouth of the extruding die.

6. An extrusion mill including an upper working room having a press with a die arranged to extrude an article in vertical direction to a lower working room, and powerfully operated shearing means mounted adjacent to the top of said lower room and at an interval beneath the die of the press in said upper room and movable transversely of the line of extrusion for severing the extruded article.

7. An extrusion mill including a press with a die arranged to extrude an article in vertical direction, a work-supporting clamp arranged adjacent to the top of said lower room but at an interval below said die, and powerfully operated shearing means mounted in the vertical interval between said die and said clamp and movable transversely of the line of extrusion for severing the extruded article.

8. An extrusion mill including a press with a die arranged to extrude an article in vertical direction, a conveyor arranged beneath said die to travel in direction transverse to the vertically extruded article, said conveyor including a device for securing the article, and means operable in the vertical interval between said device and said die for severing the extruded article when engaged by said device.

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