Sept. 27, 1932. F. W. FOLEY ET AL 1,879,336

APPARATUS FOR FORMING METAL STRIPS

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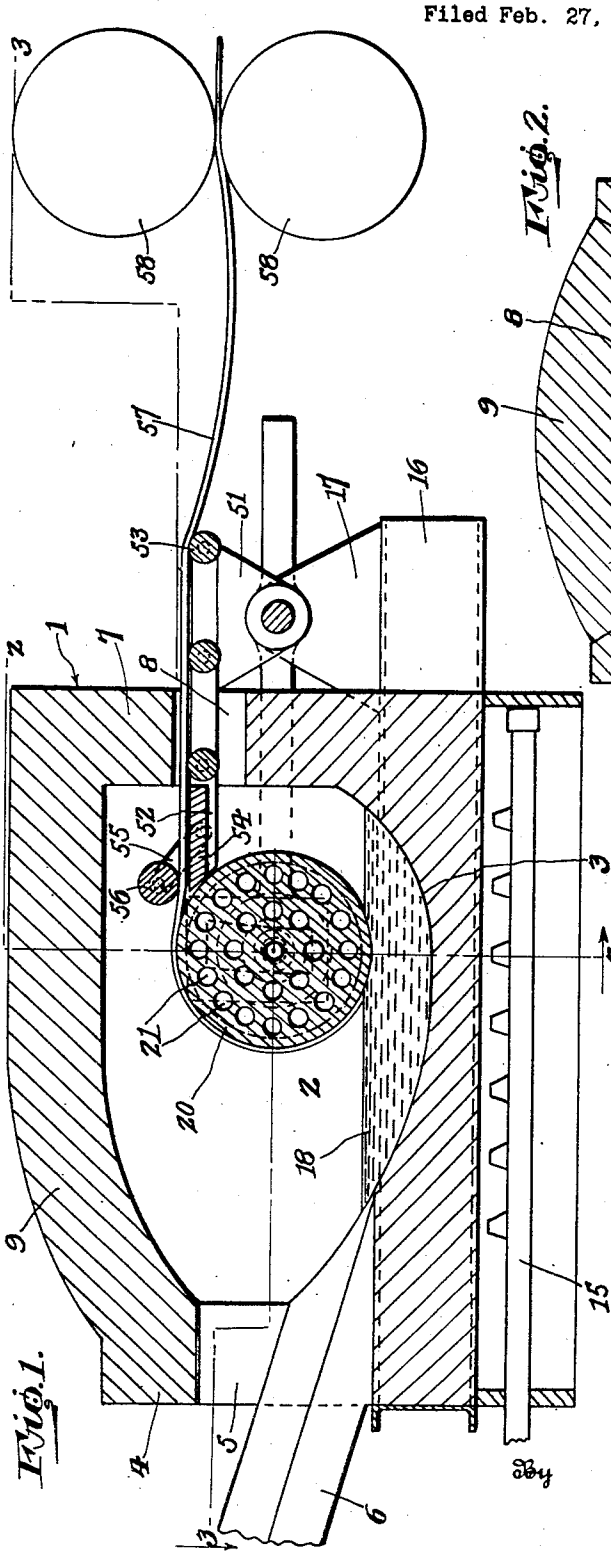


Fig. 1.

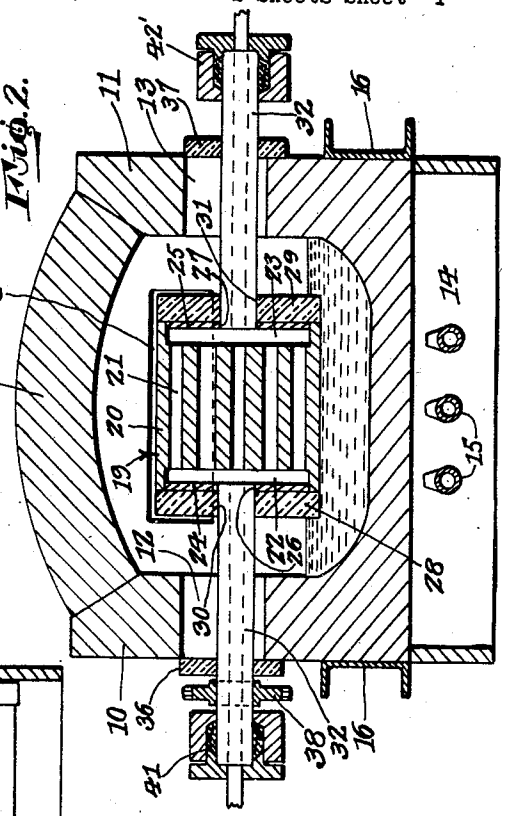


Fig. 2.

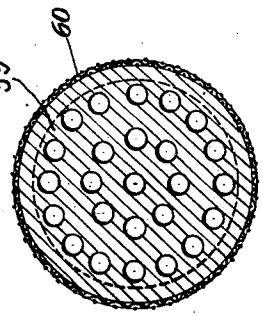


Fig. 4.

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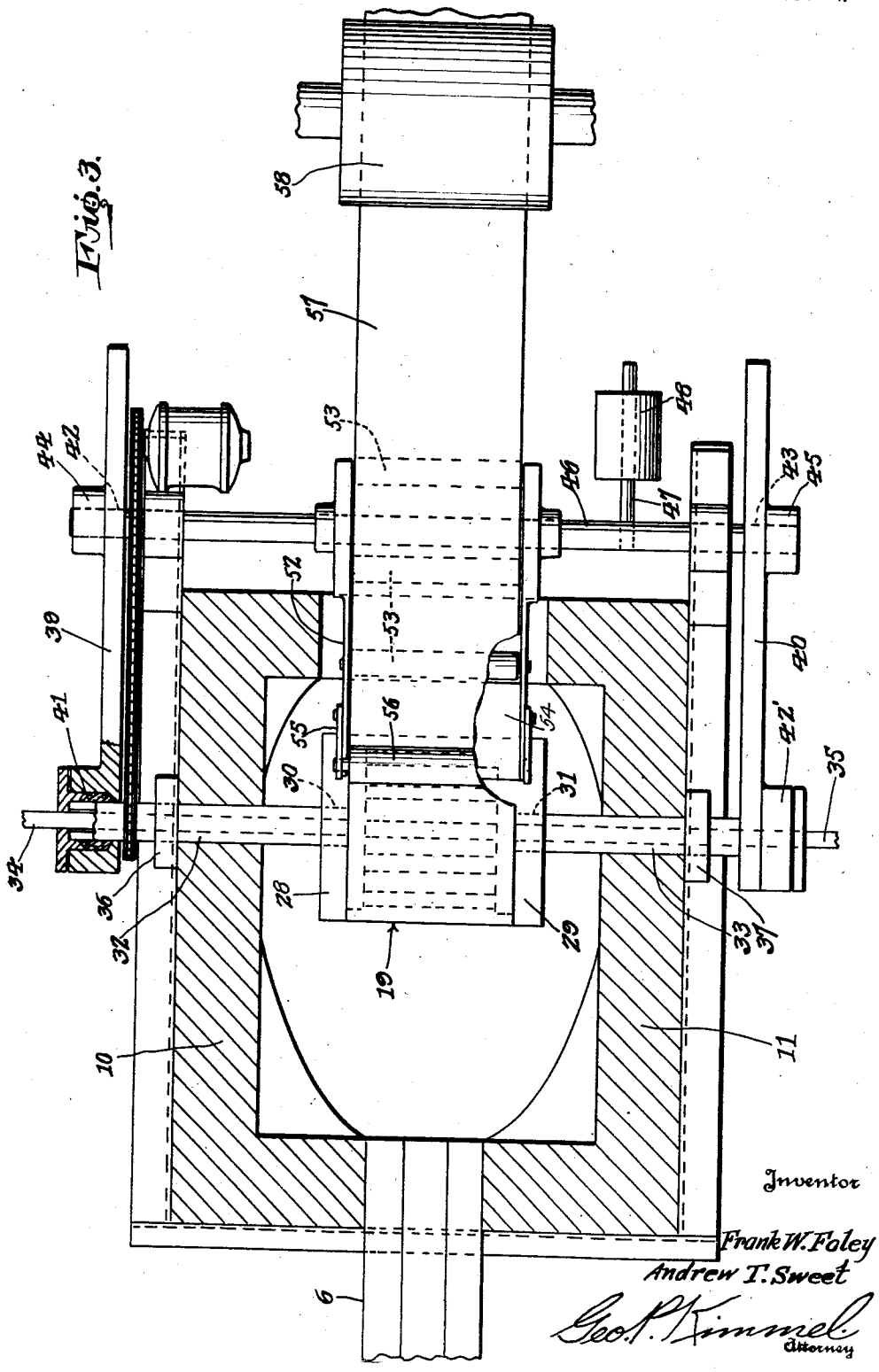
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Fig. 3.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR FORMING METAL STRIPS

Application filed February 27, 1932. Serial No. 595,542.

This invention relates to an apparatus for casting metals in strip-like form, and is designed primarily for use in connection with copper, but it is to be understood that an apparatus, in accordance with this invention may be employed for casting any other metal for which it may be found applicable, and the invention has for its object to provide, in a manner as hereinafter set forth, an apparatus of the class referred to including balanced means arranged in co-relation to a furnace for removing from the latter molten metal and for shaping and forming the latter into a strip at one operation.

A further object of the invention is to provide, in a manner as hereinafter set forth, an apparatus for the purpose referred to whereby molten metal, such as copper can be chilled by a cool metal surface and cast into a removable continuous strip from contact with the chilled surface, and immediately rolled or otherwise treated to provide a finished or semi-finished ribbon-like form.

A further object of the invention is to provide, in a manner as hereinafter set forth, an apparatus for the purpose referred to including a cooled casting element having a portion thereof operating in a body of molten metal to collect the metal thereon for the purpose of delivering it in strip-like form to suitable rolls. The casting element is continuously rotated and controlled in a manner to allow a portion thereof to rotate at a required depth in the molten metal, and with the thickness of the metal removed depending upon the speed of such element.

Further objects of the invention are to provide, in a manner as hereinafter set forth, an apparatus for the purpose referred to which is comparatively simple in its construction and arrangement, strong, durable, thoroughly efficient in its use, conveniently controlled and comparatively inexpensive to set up.

To the above ends essentially and others which may hereinafter appear, the apparatus consists of such parts, and such combination of parts which fall within the scope of the invention as claimed.

In the drawings:—

Figure 1 is a longitudinal sectional view of the apparatus.

Figure 2 is a transverse section on line 2—2 of Figure 1.

Figure 3 is a sectional plan on line 3—3 of Figure 1.

Figure 4 is a cross section of a modified form of remover element.

Referring to the drawings in detail, 1 denotes a furnace provided with a metal heating chamber 2 having a concave bottom 3. The rear wall 4 of furnace 2 is formed with an intake opening 5 and extending through the latter is a launder 6 leading from a large or main furnace, not shown for conducting tapped metal from the latter to the heating chamber 2. The front wall 7 of the furnace 1 is formed with an outlet opening 8 having its bottom arranged a substantial distance above the bottom of opening 5. The furnace 1 has a removable top 9 so it can be lifted off for the purpose of positioning a rotatable casting element in chamber 2. The side walls 10, 11 of the furnace 1 and forwardly of the vertical medians thereof are formed with vertical slots 12, 13 respectively. The bottom of furnace 1 has a combustion chamber 14 in which is arranged an oil or gas burner 15 communicating with a source of supply not shown. Secured to each side of furnace 1 and extending beyond the front of the latter is a channel iron 16. Mounted upon the forwardly extended end portions of the irons 16 are upstanding bearing brackets 17. The body of molten metal within chamber 2 is indicated at 18.

The furnace 1 is to be heated from oil or gas under automatic pyrometric control, in a known manner to obtain the correct temperature for casting the metal in sheet-like form, first from a metallurgical standpoint and then as far as possible from the mechanical, as it is well known that the temperature of the metal at casting has profound influence on its properties.

The rotatable casting element may be of any suitable contour and is illustrated by way of example as of drum-like form of uniform outer diameter. The casting element shown

in Figures 1, 2 and 3 is generally indicated at 19, and includes a metallic body part 20 of uniform diameter provided with lengthwise extending passages 21 for the travel of a cooling medium, by way of example water. Each end of body part 20 is chambered. The chambers are designated 22, 23. The passages 21 establish communication between the chambers. The chamber 22 being a cooling medium intake chamber and the chamber 23 a cooling medium outlet chamber. Secured to and arranged within the ends of body part 20 are heads 24, 25 forming closures for the chambers 22, 23 respectively. The heads 24, 25 are provided with axial openings 26, 27 respectively. Secured to the outer sides of the heads 24, 25 are end members 28, 29 formed of refractory material and provided with axial openings 30, 31 respectively which align with openings 26, 27 respectively. Fixedly secured to the heads 24, 25 are tubular rotatable shafts 32, 33 respectively and which extend through the openings 30, 31 respectively and into the openings 26, 27 respectively. Extending through shaft 32 and extended into opening 26 is a cooling medium supply pipe 34 which opens into chamber 22. Extending through shaft 33 and extended into opening 27 is a cooling medium discharge pipe 35 which leads from chamber 23. The shafts 32, 33 extend through and are vertically movable in the slots 12, 13 respectively.

Carried by the shafts 32, 33 are refractory slidable shields 36, 37 respectively for closing the slots 12, 13 and which are arranged against the outer face of the side walls of furnace 1. Adjacent to and positioned outwardly with respect to shield 36, as well as being fixed to shaft 32 is a driven sprocket wheel 38 for the purpose of rotating the element 19.

The shafts 32, 33 are supported upon the rear ends of a pair of arms 39, 40 respectively which are arranged adjacent the side walls 10, 11 respectively, extend forwardly from the front wall 7. The arms 39, 40 are arranged above and outwardly with respect to channel irons 16. The rear ends of the arms 39, 40 are provided with combined packing glands and bearing devices 41, 42' respectively for the shafts 32, 33 respectively. The pipes 34, 35 extend beyond the devices 41, 42 respectively.

The arms 39, 40 between their transverse medians and forward ends are formed with openings 42, 43 respectively and outwardly directed collars 44, 45 respectively which register with the openings 42, 43. Journaled in the brackets 17 is a rock shaft 46 which extends through openings 42, 43 and collars 44, 45 and is fixedly secured to the arms 39, 40. Extended forwardly from shaft 46 is a bar 47 upon which is adjustably mounted a counter-weight 48.

The arms 39, 40, brackets 17, rock shaft 44, bar 47 and weight 48 provide a combined supporting and counter-balancing device for the element 19 for controlling the depth of that portion of the latter which is extended into the body of metal 18.

Supported from that bracket 17 adjacent arm 39 is a motor 49 having its shaft operatively engaging with an operating power transmission endless chain 50 which engages with and drives the sprocket 38.

Mounted upon and extending upwardly from shaft 46 is a pair of supports 51 positioned at the front of outlet opening 8. Carried by the supports 51 and extending rearwardly therefrom to a point in close proximity to the top of element 19 is a pair of parallel bars 52 having arranged therebetween and supported therefrom spaced rotatable rolls 53. The rear ends of the bars 52 are shaped to provide doctors or strippers 54. Extending upwardly from the bars 52 at a rearward inclination, as well as being connected to the latter, are supports 55 for a guide roll 56 arranged over the doctors or strippers 54. The cast metal sheet, indicated at 57 passes between the roll 56 and the doctors or strippers 54. The rolls 53 provide a support for the cast metal sheet 57 as it travels forwardly from the furnace 1 to the roughing rolls 58 or first rolls in the train for finishing the metal strip. The finished product will be a continuous ribbon that can be wound on rolls.

Figure 4 of the drawings illustrates a modified form of a rotatable casting element indicated at 59 and which is of the same form as element 19, with this exception that it is provided with a reticulated sheet 60 to provide for the chilled metal to follow the casting element, in case the metal will not otherwise follow the periphery of such element.

The end members prevent the metal being chilled at the ends of casting element and thus hindering stripping. The combined supporting and counter-balancing device provides automatic regulation of the depth of immersion to take care of any fluctuations in the supply of molten metal from the main furnace. The cooling water supply can be controlled in any desirable manner.

The apparatus provides for the chilling of the metal by a continuously rotated cool metal surface continuously passing through a body of molten metal, the solidified metal being removed from the molten metal as a continuous strip originally in contact with the chilled surface, the strip being continuously removed from the chilled surface and immediately rolled or otherwise treated to produce a finished or semi-finished product of ribbon-like form.

What we claim is:—

1. In an apparatus for casting metal into strip-like form, a furnace including a heat-

ing chamber adapted to contain a body of molten metal, a counter-balanced, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body chilling and casting thereon in strip-like form metal removed from said body, and means opposing said element for continuously removing the metal strip from the latter.

2. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a counter-balanced, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body chilling and casting thereon in strip-like form metal removed from said body, and a support extending into said chamber provided intermediate its ends with supporting rollers for supporting the strip and at its inner end with doctors for continuously removing the strip from said element.

3. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a counter-balanced, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body chilling and casting thereon in strip-like form metal removed from said body, a support extending into said chamber provided intermediate its ends with supporting rollers for supporting the strip and at its inner end with doctors for continuously removing the strip from said element, and a guide roller arranged above the doctors and over the strip as it passes off of said element.

4. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, and a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace.

5. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, said furnace having an outlet at its front, and means extending rearwardly through said outlet and opposing said element for continuously removing the strip from the latter.

6. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, said element provided with passages for the travel therethrough of a chilling medium, and a chilling medium conducting means extending through said shafts and communicating with said passages.

7. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, said furnace having an outlet at its front, means extending rearwardly through said outlet and opposing said element for continuously removing the strip from the latter, said element provided with passages for the travel therethrough of a chilling medium, and a chilling medium conducting means extending through said shafts and communicating with said passages.

8. In an apparatus for casting metal into strip-like form. a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, refractory end members secured to said element, said furnace having its body portion provided with aligning slots for the passage of said shafts, and shields carried by the shafts for closing the slots.

9. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten

metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, said element provided with passages for the travel therethrough of a chilling medium, a chilling medium conducting means extending through said shafts and communicating with said passages, refractory end members secured to said element, said furnace having its body portion provided with aligning slots for the passage of said shafts, and shields carried by the shafts for closing the slots.

10. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, and a combined doctor means and supporting structure for the strip, the doctor means being positioned in proximity to said element for continuously removing the strip therefrom.

11. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, said furnace having an outlet at its front, and a combined doctor means and supporting structure for the strip, the said structure arranged within and extended from said chamber through said outlet, and the doctor means of said structure being positioned in proximity to said element for continuously removing the strip therefrom.

12. In an apparatus for casting metal into strip-like form, a furnace including a heating chamber adapted to contain a body of molten metal, a vertically movable, continuously chilled and continuously rotated casting element arranged in said chamber for partial submergence in said body for chilling and casting thereon in strip-like form metal removed from said body, rotatable shafts connected to said element, a combined supporting and counter-balancing device for said element connected to said shafts and arranged exteriorly of the furnace, a combined doctor means and supporting structure for the strip, the doctor means being positioned in proximity to said element for continuously removing the strip therefrom, and a guide roll supported from said structure and above said doctor means.

In testimony whereof, we affix our signatures hereto.

FRANK W. FOLEY.
ANDREW T. SWEET.