Sept. 28, 1965 A. W. SCRIBNER 3,208,112

METAL CASTING METHOD AND APPARATUS

Original Filed Nov. 1, 1961

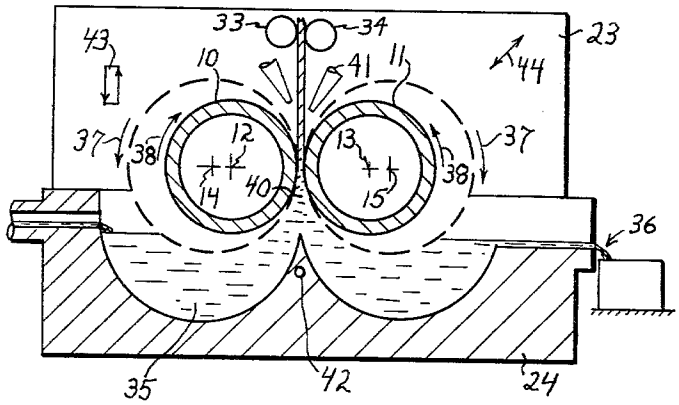


Fig. 1

Fig. 2

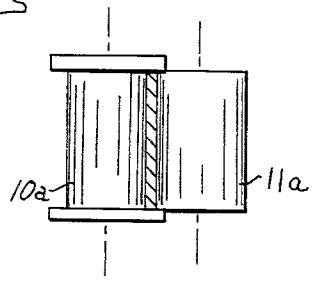
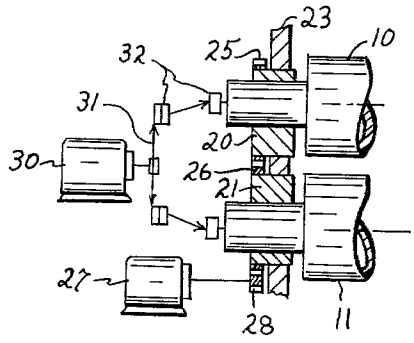


Fig. 3



INVENTOR.

BY Albert W. Scribner

United States Patent Office 3,208,112 Patented Sept. 28, 1965

3,208,112

METAL CASTING METHOD AND APPARATUS

Albert W. Scribner, 6 Country Club Road, Darien, Conn.

Original application Nov. 1, 1961, Ser. No. 149,378, now Patent No. 3,120,037, dated Feb. 4, 1964. Divided and this application Oct. 30, 1963, Ser. No. 320,069
9 Claims. (Cl. 22—57.5)

This invention relates to the continuous casting of metal and the like so as to form elongated strip type products. This application is a divisional application of my co-pending parent application Ser. No. 149,378 filed November 1, 1961, for Continuous Casting; now U.S. Patent #3,120,037.

One object of the invention is to provide a novel method and apparatus for continuous casting of metal whereby a rapid plurality of successive impact working strokes are applied to the side of the work metal that is progressively hardened while moving through an open ended casting passage.

One object of the instant invention is to provide a novel method and apparatus for continuously casting metal whereby a plurality of mold parts are oscillated at high speed so as to more efficiently conduct the work metal through an open ended casting passage defined by said mold parts.

Another object of the invention is to provide a novel method and apparatus for continuously casting metal whereby forming and feeding forces are applied to the sides of the work metal by the high speed intermittent contact of an operative mold casting surface with the said sides of the work metal.

Other objects of the invention will become apparent as the disclosure progresses.

In the drawings:

FIG. 1 is a sectional side elevational view illustrating one embodiment of the instant invention.

FIG. 2 is a fragmentary plan view illustrating a modified version of the FIG. 1 apparatus.

FIG. 3 is a fragmentary plan view in partial section illustrating a portion of the apparatus of FIG. 1.

The continuous casting system shown in FIG. 1 contemplates the provision of a pair of cooperating casting members that are mounted for vibratory type movement whereby the linear or arcuate cyclic oscillations thereof serve to feed, cool and form the molten metal to be cast. The embodiment shown in FIG. 1 comprises a pair of cooperating tubular casting rolls or drums **10** and **11** that are mounted for rotation about their respective axes **12** and **13** and also for independent timed planetary or eccentric movement about the respective axes **14** and **15** as illustrated by the dotted line circles. The eccentricity between the axes of rotation and planetation have been exaggerated here for the purpose of clarity; the actual eccentricity being in the order of a fraction of an inch.

The rolls **10** and **11** are rotatably mounted in eccentrically disposed apertures formed in the bearing bushings **20** and **21**, FIG. 3, which in turn are rotatably mounted in the side frames **23** that are secured to a container **24**. The bushings **20**, **21** are rotatably interconnected by suitable gears **25** and **26** which are driven by a motor **27** through a suitable pinion **28** and in this manner the rolls **10**, **11** may be planetated in synchronism. Each roll is also adapted to be rotatably driven about their respective axes by means of a motor **30** through suitable gearing such as **31** and universal joints **32**. Thus a controlled separate rotative driving or braking force may be applied to rolls **10**, **11** during planetation thereof. The planetary movement of rolls **10**, **11** serves to impart a continuous series of working strokes or impacts to the side of the work metal that is progressively moving through the casting passage effectively defined by the

operational peripheral casting surfaces of said rolls. Thus the work metal is progressively hardened, formed, reduced and fed along the casting passage. The rolls **10**, **11** may be provided with suitable end flanges, or stationary frame mounted flanges may be used, to close the gap between the respective ends of said rolls thereby completing the closed sectional profile of the casting passage of the mold means. A driven pair of pinch rolls **33**, **34** rotatably mounted on the side frames serve to apply a tension force to the metal strip leaving the casting station.

The rolls **10**, **11**, which may be provided with suitable cooling means, are disposed over the container **24** so as to be slightly immersed in the reservoir of molten metal **35** during their working strokes, and molten metal **35** may be maintained at a substantially constant level by overflow means **36**. The direction of planetation is indicated by arrows **37** while the direction of rotation of rolls **10**, **11** is respectively opposite as indicated by arrows **38**. The relative rates of planetation and rotation of each roll may be such that the net peripheral speed of the outer roll surface produces a true rolling or rocking movement as the roll swings upwardly while in contact with the work metal **40** between said rolls. Said relative speeds may be adjusted so that the operative roll surfaces impart a net upward or downward frictional force to the roll contacting skin surfaces of the freezing metal **40** by means of said driving or braking forces as applied to rolls **10**, **11** by motor **30** and gearing **31**, **32**. As the rolls swing through each cyclic eccentric movement a small portion of work metal is thereby gathered and the minute pumping action of the eccentrically moving rolls tends to feed the metal up between the rolls. This eccentric movement also tends to percussively form the freezing work metal **40** and to thereafter force the metal through the roll gap. The speed of planetation is made high enough to overcome the tendency of the work metal **40** to fall back between the intermittent gathering actions of the eccentrically moving rolls, these speeds being in the order of 10 to 30 cycles or revolutions per second or higher. During the periodic short time intervals that the rolls surfaces are out of contact with the work metal **40** a cooling gas from nozzles **41** may circulate around the rolls. The bottom of container **24** may be contoured as shown and provided with cooling passages **42** or similar means to help in cooling the central part of the work metal **40**.

The phase relation between roll planetary movement may be varied, and one or more of the various rotational and planetary directions may be reversed so that various combinations of phase and direction of roll movement may be obtained. One of the rolls **10**, **11** may be provided with end flanges and the roll surfaces may be roughened or slightly grooved to increase the gathering and pumping action mentioned above. The rotational speed and/or planetary speed for one roll may be different from that of the other roll. Also the eccentricity of the respective roll movement may be different.

A modification of the apparatus of FIG. 1 is illustrated in FIG. 2. Here the larger diameter roll **11***a*, which may have a suitable cooling means is mounted for rotational movement only. The smaller flanged roll **10***a* is mounted for rotational and planetary movement as above described for rolls **10** or **11**, the degree of eccentricity or the radius of planetation of the outer surfaces of roll **10***a* being substantially the same as the effective radius of the larger roll **11***a*. Instead of being mounted for circular oscillation as in FIGS. 1 and 3 the casting rolls may be oscillated through closed loop rectangular type or linear strokes as illustrated by arrows **43** and **44** of FIG. 1. Also the work metal may be fed to the top of rolls **10**, **11**. In place of either roll **10***a* or **11***a* a stationary anvil may be used having a concave cylindrical surface which cooperates

with the other roll so as to form an arcuately extending casting station.

While several embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that numerous variations and modifications may be made in the particular construction without departing from the underlying principles of the invention. It is therefore desired by the following claims to include within the scope of the invention all such variations and modifications whereby substantially the results of the invention may be obtained by the use of substantially the same or equivalent means.

The invention claimed is:

1. A method of continuously casting metal: comprising the steps of

providing a source of work metal;

establishing an open ended casting passage through which said work metal may pass in being progressively cast;

positioning at least one casting roll so as to effectively define a portion of said casting passage;

progressively admitting work metal to said casting passage;

rapidly translating said casting roll relative to said work metal so that said casting roll successively rolls over the side of the work metal in said casting passage whereby rapid successive rolling work strokes are applied to the work metal that is progressively passing through said casting passage, the rolling advance of said casting roll during said rolling work strokes thus being substantially independent of any bodily advancing movement of the work metal then in said casting passage; and

progressively withdrawing cast work metal from said casting passage.

2. The method defined by claim **1**: additionally comprising

controlling said translational movement of said casting roll so that the latter swings successively into and out of engagement with the said side of the work metal in said casting passage while moving through a substantially closed loop path whereby the successive rolling work strokes of said casting roll occur in the same rolling direction.

3. The method defined by claim **1**: additionally comprising

controlling the translating movement of said casting roll so that the latter oscillatably rolls back and forth over the side of the work metal passing through said open ended casting passage.

4. The method defined by claim **1**: additionally comprising

applying a superimposed rotational torque to the casting roll during the rolling work strokes of the latter whereby longitudinal forces may be applied by said casting roll to the said side of the work metal passing through said casting passage.

5. The method defined by claim **1**: additionally comprising

positioning a second casting roll in opposed cooperating relation with respect to the first mentioned roll so as to effectively define another portion of said casting passage; and

controlling the motion of said second roll whereby a succession of mutually timed roll working forces may be applied to opposite sides of said work metal passing through said casting passage.

6. In an apparatus for continuously casting metal:

a frame;

a pair of casting members operatively supported by said frame in opposed and cooperating relation so as to define at least a portion of an open ended casting passage, at least one of said casting members comprising a casting roll;

the supporting means for said casting roll including,

bearing means for supporting said casting roll for rotational movement about the roll axis, and

mounting means carried by said frame for supporting said bearing means so that said casting roll may partake of a planetary movement;

drive means for swinging said casting roll through its planetary movement so that rolling work strokes may be applied to the work metal in said casting passage; and

torque applying means for applying a superimposed rotational torque to said casting roll during the said planetary movement thereof whereby longitudinal forces may be applied by said casting roll during said rolling work strokes to the side of the work metal that is in said casting passage.

7. Apparatus as defined by claim **6** wherein the other of said casting members comprises a second casting roll, and wherein the said planetary movement of the first mentioned casting roll occurs in a plane that is substantially parallel to the plane of movement of the work metal through said casting passage.

8. In an apparatus for continuously casting metal:

a frame;

a plurality of bearing members rotatably mounted on said frame;

a pair of opposed and cooperating casting rolls rotatably mounted in said bearing members, the axes of each of said casting rolls and the associated bearing members being eccentrically offset whereby each of said casting rolls is capable of partaking of simultaneous rotational and planetary movement;

the cooperating operative surfaces of said opposed casting rolls defining at least a portion of an open ended casting passage;

means for rotatably interconnecting the related bearing members for mutually timed rotational movement; and

drive means for rotatably driving said bearing members whereby said casting rolls are thereby planetated in timed relation and are arcuately swung towards and away from each other so as to substantially simultaneously impart successive rolling work strokes to the opposite sides of the work metal moving through said casting passage.

9. Apparatus as defined by claim **8**: additionally comprising

torque applying means for applying a superimposed rotational torque to said casting roll during the said planetary movement thereof whereby longitudinal forces may be applied by said casting roll to the side of the work metal that is in said casting passage.

References Cited by the Examiner

UNITED STATES PATENTS

2,171,132	8/39	Simons	22—57.5 XR
2,698,978	1/55	Welblund	22—200.1
2,790,216	4/57	Hunter	22—57.5
3,075,264	1/63	Wognum	22—57.3

FOREIGN PATENTS

1,301,977	7/62	France.

J. SPENCER OVERHOLSER, *Primary Examiner.*

MARCUS U. LYONS, *Examiner.*