United States Patent [19]

Properzi

[11] **3,710,846**

[45] **Jan. 16, 1973**

[54] **CONTINUOUS CASTING APPARATUS**

[76] Inventor: **Ilario Properzi,** Via Vittor Pisani 8, Milan, Italy

[22] Filed: **Dec. 22, 1970**

[21] Appl. No.: **100,654**

[30] **Foreign Application Priority Data**

Jan. 14, 1970 Italy.....1935 A/70

[52] **U.S. Cl.**.....**164/278**

[51] **Int. Cl.**.....**B22d 11/06**

[58] **Field of Search**.....164/278, 46, 51, 64, 87, 263, 164/268, 269, 276, 277, 325

[56] **References Cited**

UNITED STATES PATENTS

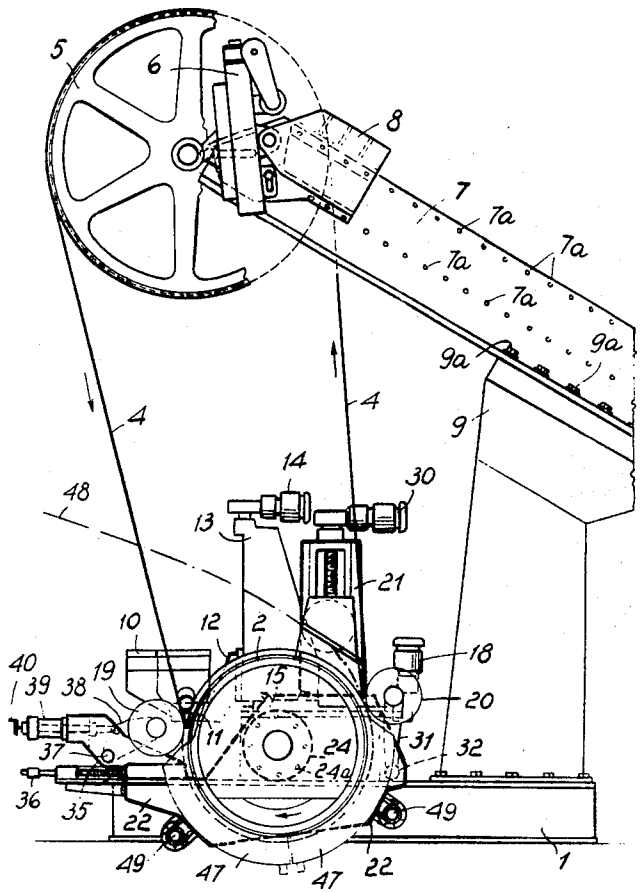
2,710,433	6/1955	Properzi	164/278
3,331,431	7/1967	Bray	164/278 X
3,452,808	7/1969	Properzi	164/278
3,533,463	10/1970	Hazelett	164/278

Primary Examiner—J. Spencer Overholser
Assistant Examiner—John S. Brown
Attorney—Guido Modiano and Albert Josif

[57] **ABSTRACT**

A continuous casting apparatus having a rotating grooved casting wheel cooperating with a continuous rib wound on the said casting wheel, a support unit connected to the said casting wheel and securable to said apparatus at a number of angular positions for positioning a crucible at the periphery of the said casting wheel.

11 Claims, 10 Drawing Figures



PATENTED JAN 16 1973

3,710,846

SHEET 1 OF 6

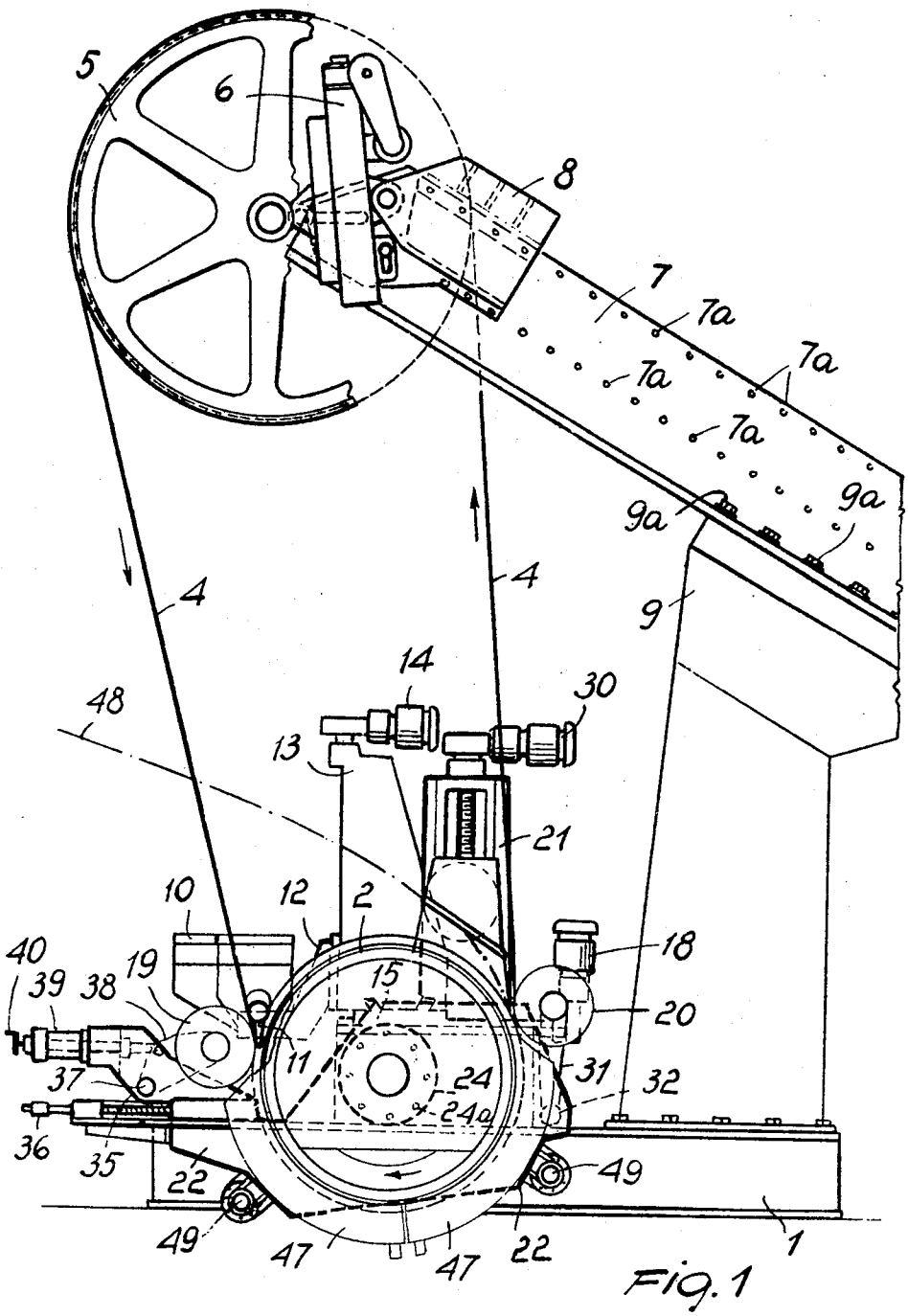


Fig. 1

BY

Ilario PROPERZI

INVENTOR.

Albert Josif

AGENT

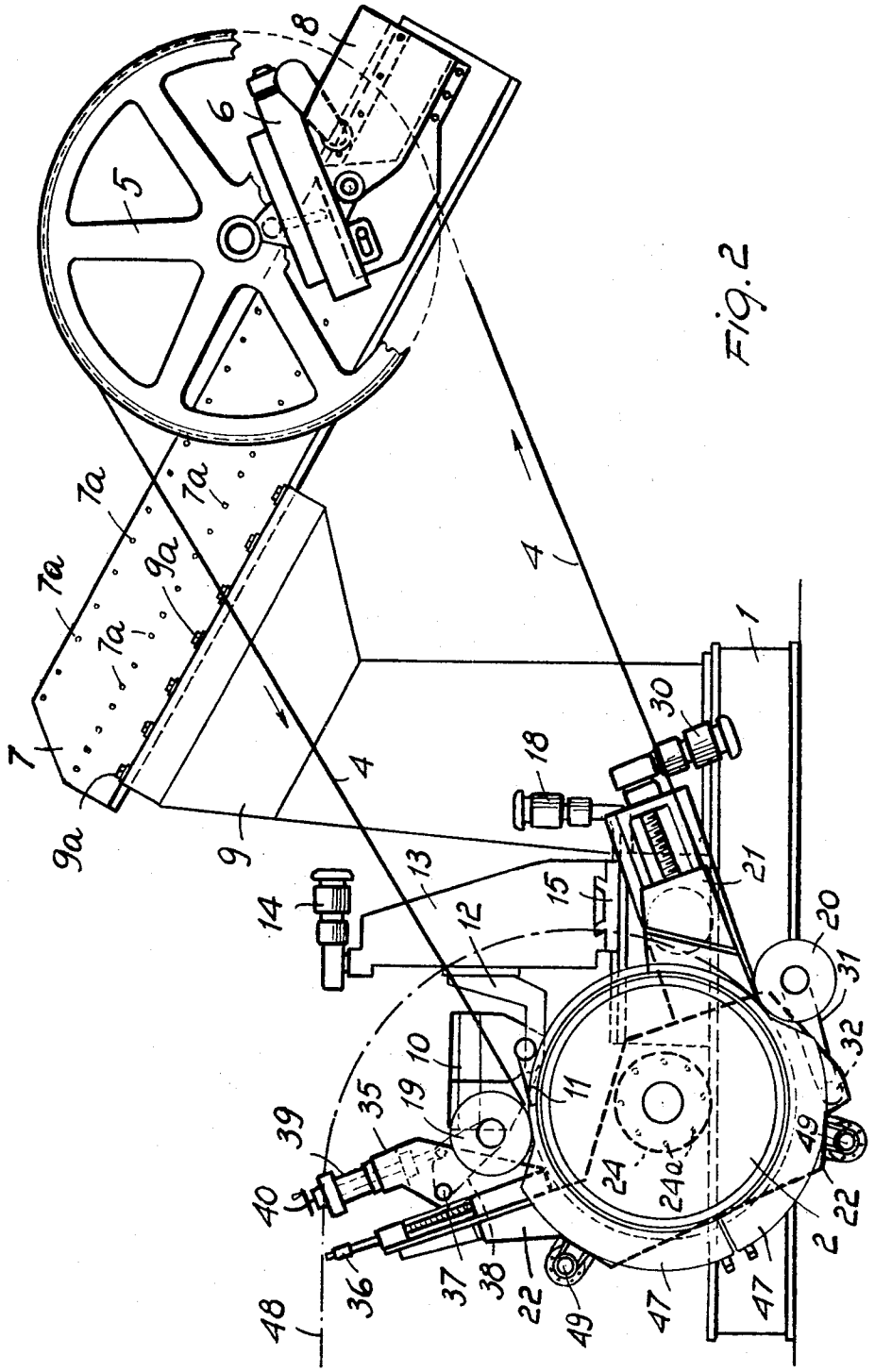


Fig. 2

INVENTOR
Mario PROPERZI
BY
Albert Josif
AGENT

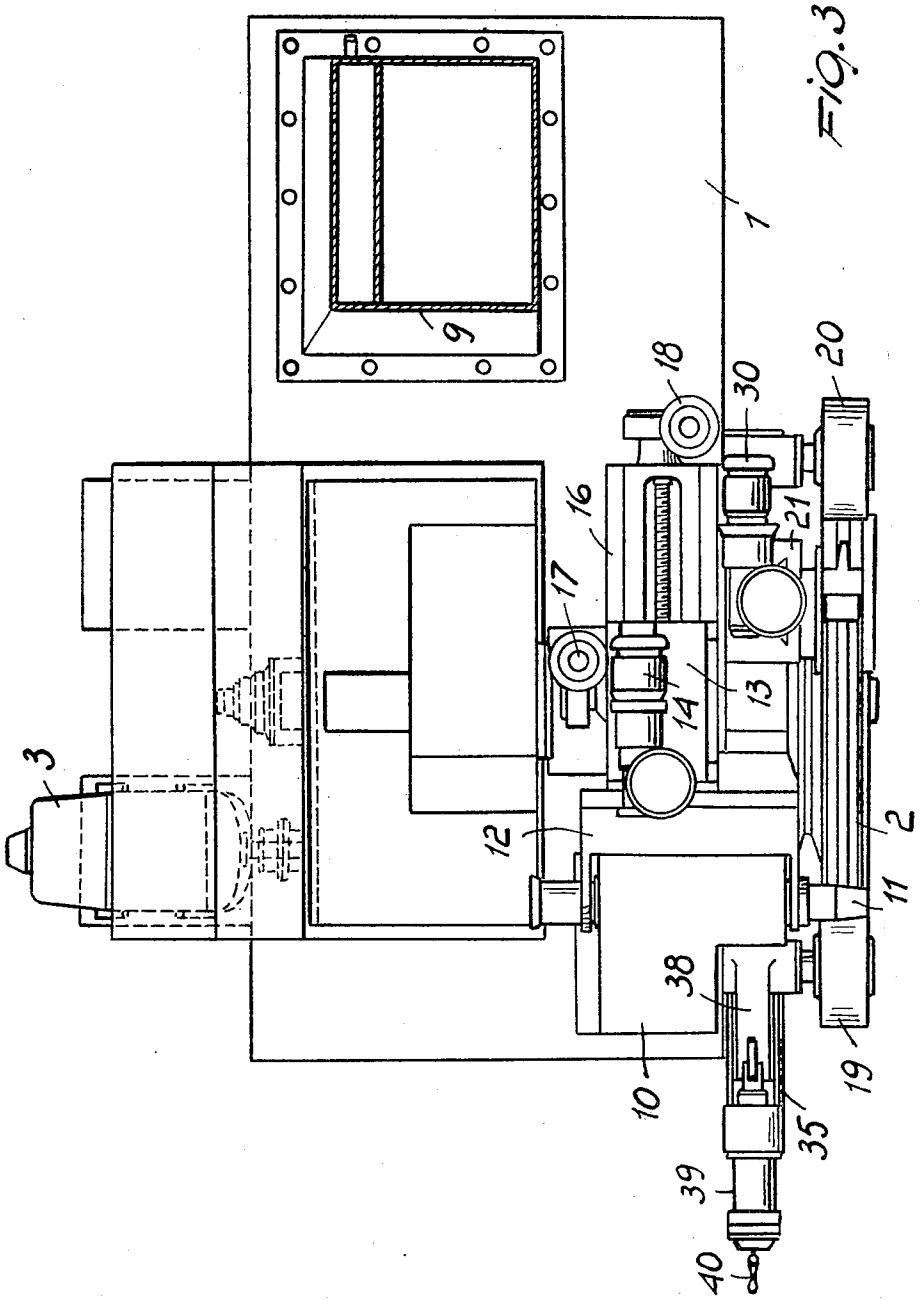


Fig. 3

INVENTOR
Ilario PROPERZI
BY
Albert Josif
AGENT

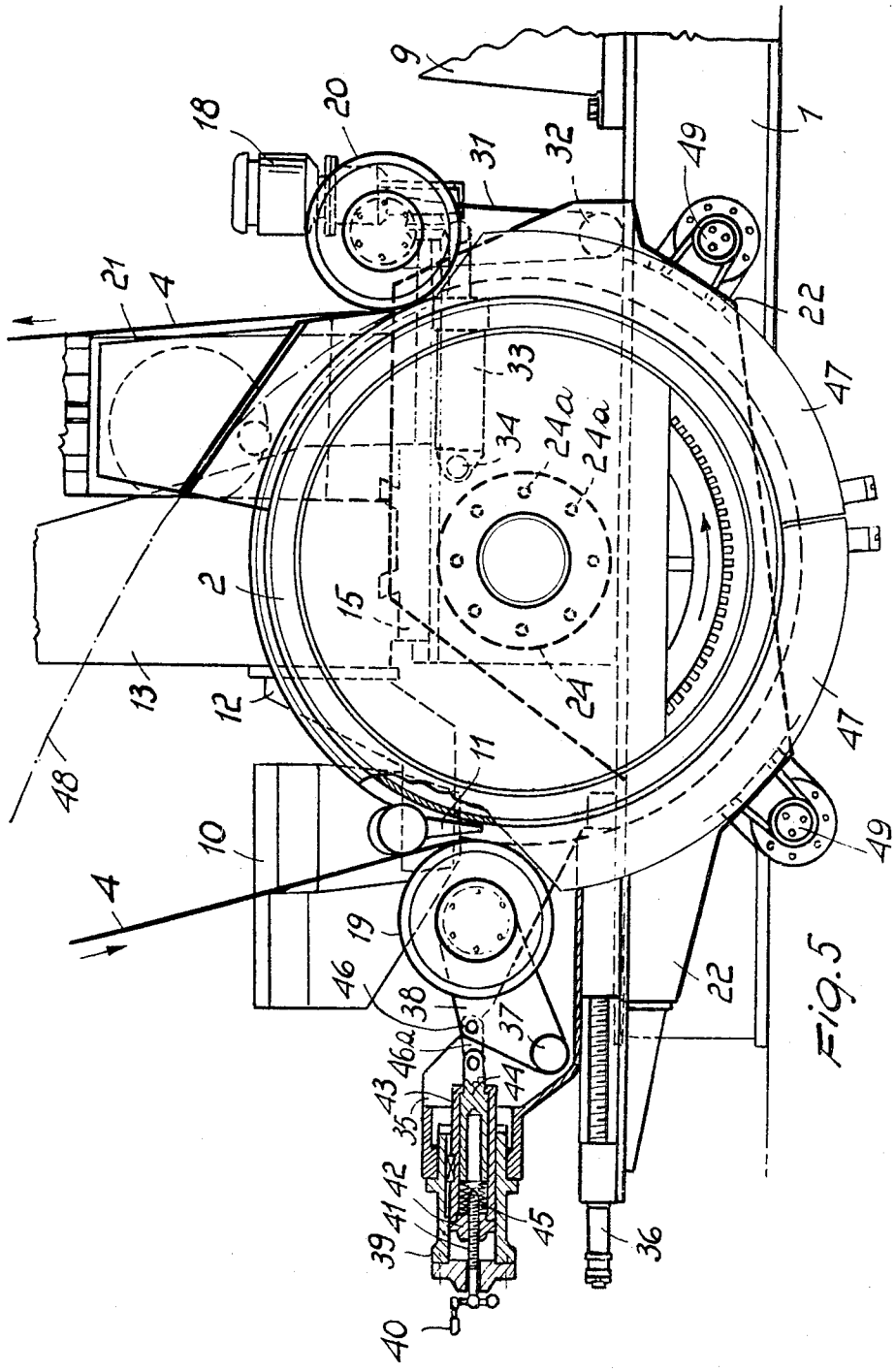


Fig. 5

INVENTOR
Ilario PROPERZI

BY

Albert Josif
AGENT

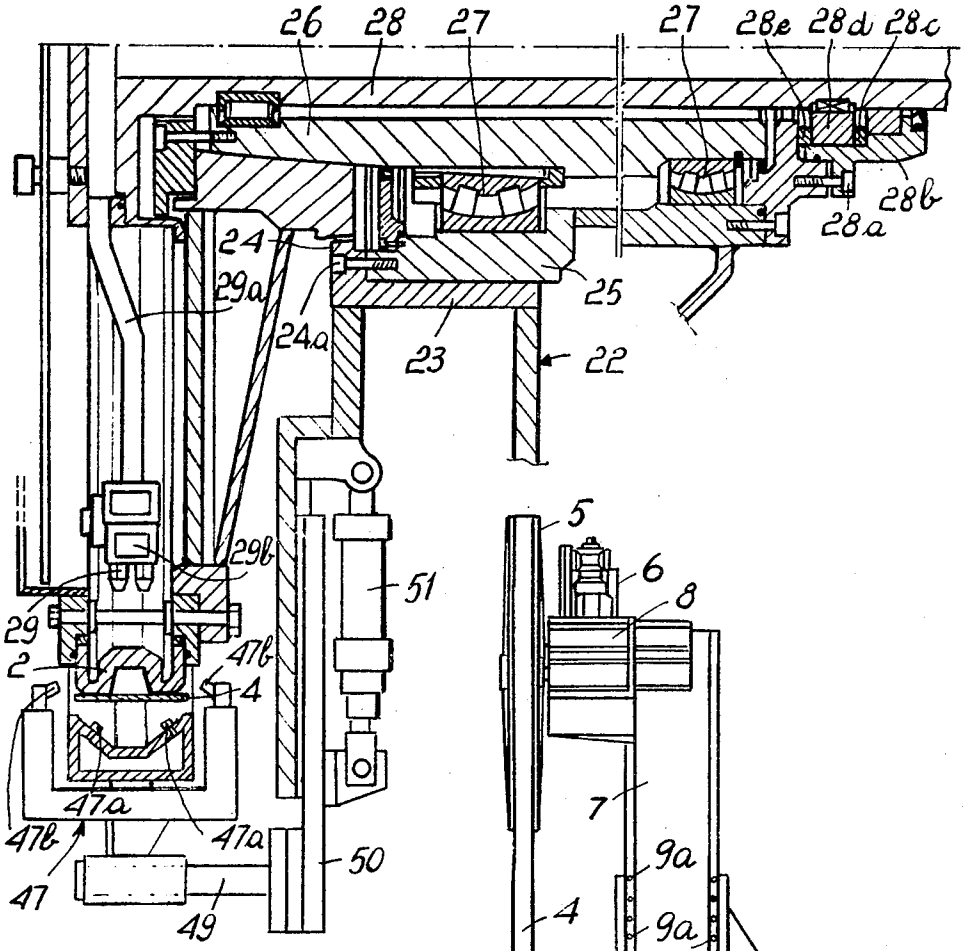


Fig. 6

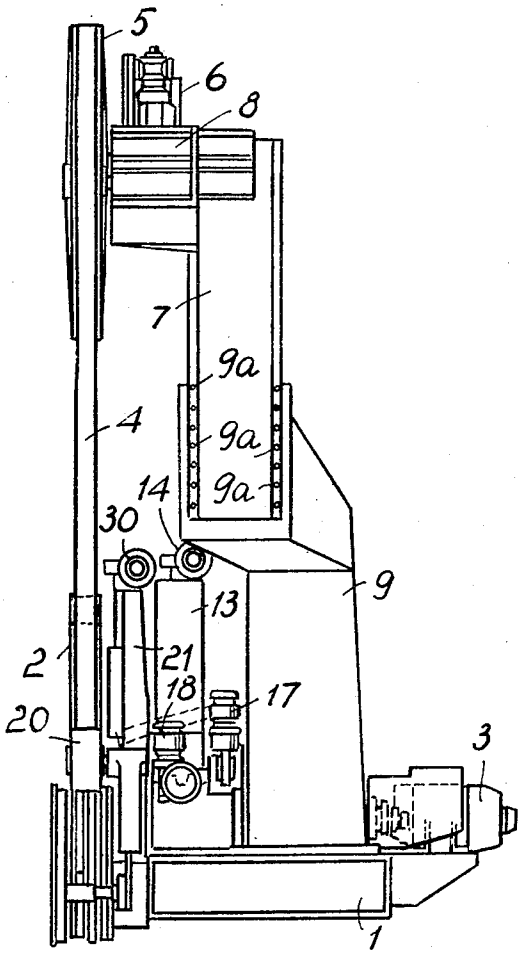


Fig. 4

INVENTOR
Ilario PROPERZI
BY
AGENT

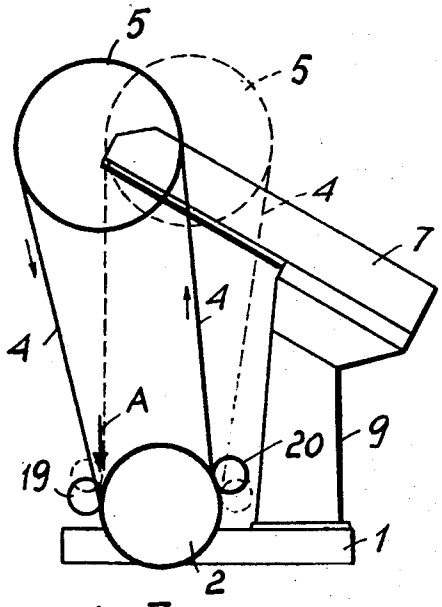


Fig.7

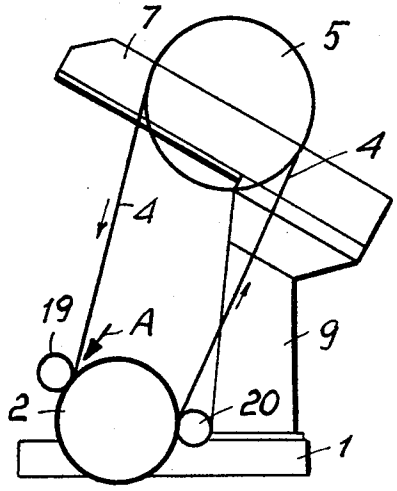


Fig.8

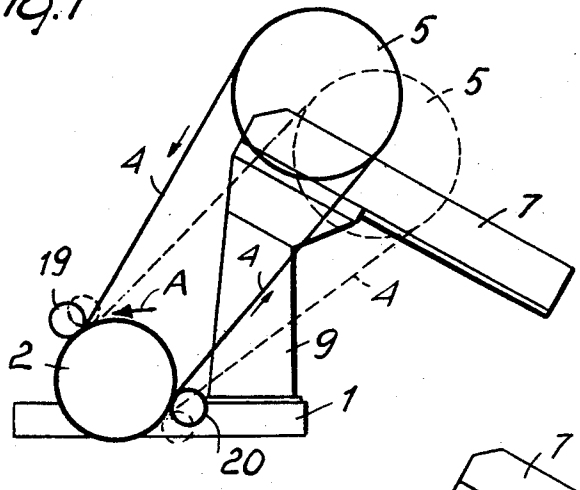


Fig.9

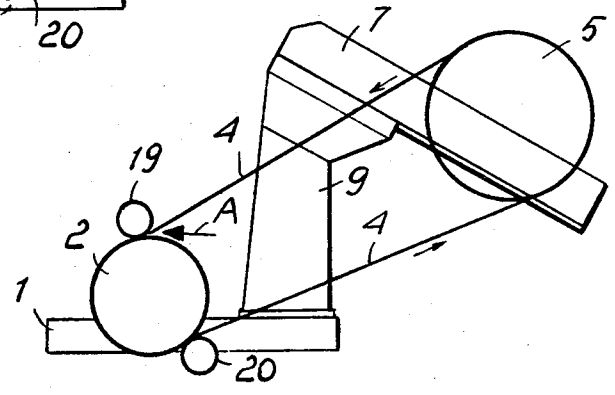


Fig.10

INVENTOR
Ilario PROPERZI
BY
Albert Josif
AGENT

CONTINUOUS CASTING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to a continuous casting apparatus for producing continuous metal ingots or rods.

In the known continuous casting machines having a rotating casting wheel provided with a peripheral groove in which molten metal is poured to obtain a continuous metal ingot, the casting nozzle is arranged with its axis inclined at a greater or lesser angle depending upon the kind of metal being cast or the casting process. Thus it is necessary that the said nozzle should be arranged in a horizontal, vertical or otherwise inclined plane.

Of course the position of the crucible at the casting wheel differs from one machine to another depending upon the desired direction of the casting jet.

Accordingly also other components of the casting machine will be variously positioned, such as the metal tape or ribbon which partially wraps the casting wheel to close along a circumferential section the peripheral groove or casting mold, and the transmission means for the said tape and the take-off means for withdrawing the ingot from the casting wheel.

In other terms the casting machines used at present are designed and manufactured according to different arrangements in view of the desired casting directions and thus the casting positions.

SUMMARY OF THE INVENTION

One object of the present invention is that of conceiving a continuous casting apparatus which may be used for casting metals in directions varying within a wide range in order to meet any casting orientation requirement with a single structure.

Another object of this invention is that of providing means allowing an easy and rapid setting of the casting machine in any working checking, replacement and adjusting steps and the like.

According to the invention there is provided a continuous casting apparatus for producing continuous metal ingots or rods, comprising a casting wheel transmissively connected to relative power means and formed with a peripheral mold-like groove which is closed along a length thereof by a continuous tape or ribbon wound on the said casting wheel and around idle rollers, the said apparatus being characterized in that it further comprises a support unit connected to said casting wheel and mounted for rotation around the shaft thereof and capable of being secured to the frame of the apparatus at a number of angular positions, two idle rollers for the said tape carried by the said support unit at the periphery of said casting wheel, a taking-off or extraction means for withdrawing the produced ingot mounted on the said support unit, an idle pulley for the said tape which may be set in a plurality of positions relative to the said angular positions of the said support unit and is mounted on a support member rigid with the said frame, and a crucible which can be mounted in a number of positions at the periphery of the said casting wheel.

The invention will be better understood from the following detailed description of a preferred not exclusive embodiment of a continuous casting apparatus for producing continuous metal ingots, reference being made to the accompanying drawings in which:

FIG. 1 is a side view of the casting apparatus according to the invention set to cast in a vertical direction;

FIG. 2 is a side view of the same apparatus set to cast in a substantially horizontal direction;

FIG. 3 is a top plan view, partially in section, of the apparatus shown in FIG. 1;

FIG. 4 is a side view of the apparatus shown in FIG. 1;

FIG. 5 shows a detail in FIG. 1 in an enlarged scale;

FIG. 6 is a partial axial section view in an enlarged scale of the apparatus taken through the casting wheel;

FIGS. 7, 8, 9 and 10 diagrammatically illustrate the various positions in which the apparatus according to the invention can be arranged.

With reference to the above Figures the continuous casting apparatus according to the invention comprises a frame 1, a casting wheel 2 mounted for rotation around an horizontal axis and powered by a motor 3 through a suitable reduction unit. Along a section of the periphery of the casting wheel 2 a metal tape 4 is wound which is also wound around a pulley 5 having an horizontal axis of rotation and arranged at a distance from the said casting wheel. The pulley 5 is provided with a tensioning unit 6 which is in turn supported by an overhanging beam 7 through a frame 8. The beam 7 is secured in a tilted position at the top of an upright 9 rigid with the main frame 1.

The structure or frame 8 can be secured in a plurality of positions along the beam 7 which is formed with a plurality of holes 7*a*. The securing of the structure 8 is effected by means of bolts. Similarly the beam 7 may be arranged in different positions on the the top of the upright 9 by means of bolts 9*a*.

A crucible 10 provided with an orientatable nozzle 11 is mounted vertically and horizontally movable on a fork member 12. The latter may be moved vertically along a support 13 by a motor and reduction gear unit 14 which controls a worm-nut assembly. The support 13 may be moved parallel to the axis of rotation of the wheel 2 along a slide 15 which in turn can be moved in a direction at right angles to the same axis along fixed horizontal guides 16. The movement of the support 13 on the slide 15 occurs through a motor 17 which controls a worm-nut assembly by means of a reduction gear. Similarly the movement of the slide 15 along the guides 16 is due to the action of a motor 18 which powers a worm-nut assembly through a relative reduction gear.

With such an arrangement it is possible to move the crucible 10 in such a manner so as to locate the relative nozzle in various positions within the groove of the casting wheel 2.

According to the invention rollers 19 and 20 for the tape 4 adjacent to the casting wheel 2, as well as a taking-off unit 21 for withdrawing the continuous ingot from the casting wheel are mounted for rotation through an angle about the axis of rotation of the casting wheel 2 and can be fixed in various positions.

To this end a drum-like support 22 is co-axially mounted for rotation near the casting wheel 2. More particularly the support 22 is provided with a central sleeve 23 (FIG. 6) which is flanged at 24 and connected to a fixed sleeve 25 into which the hollow shaft 26 carrying the wheel 2 is inserted by means of bearings 27 placed therebetween. At the flange 24 securing screws 24*a* are screwed into the sleeve 25, thus secur-

ing the support 22 in the desired position. According to known inner cooling arrangements a fixed conduit 28 is provided within the hollow shaft 26 to supply cooling water to the nozzles 29 (FIG. 6) for cooling the inside of the casting wheel 2.

The taking-off unit 21 mounted on the support 22 and rotating therewith, comprises a motor 30 which causes the unit 21 to move by means of a reduction unit and a worm-nut assembly. In such manner the taking-off unit can be moved to a position in register with the groove of the wheel 2 or it may be disengaged for allowing the wheel to be replaced or other maintenance and control operations.

The rollers 19 and 20 are connected to the support 22 so as to be able to be moved towards and from the wheel 2, so that the same may be moved from the work to the non-operative position (such as to allow replacement of the tape 4) or viceversa.

More precisely the roller 20 is connected to the support 22 by means of an arm 31 pivoted at 32 on the support 22 and articulated to a piston rod of a fluid-operated cylinder 33 (FIG. 5) which in turn is articulated at 34 to the support 22. In this manner by causing the cylinder 33 to operate it is possible to move the roller 20 towards and away from the wheel 2.

Similarly the roller 19 is mounted on a slide 35 which can be moved along relative guides rigid with the support 22, by means of a worm-nut assembly controlled by a fluid operated unit 36. In this way the roller 19 can be moved towards and away from the wheel 2. The roller 19 can effect an oscillatory movement about the pin 37 on the slide 35 through an arm 38 carrying the roller. The arm 38 can rotate about the pin 37 through an angle such as 10° 15′ by means of a device 39 controlled by a handwheel 40. More precisely the handwheel 40 is rigid with a screw 41 in threading engagement with a nut 42 integral with a tubular member 43 axially sliding within the housing or envelope of the device 39. A piston pin 44 is slidably mounted in the tubular member 43 and on one side engages with cup springs 45 held in position by the nut 42 and on the other side is articulated at 46 to the arm 38 carrying the roller 19 with the interpositioning of a connecting rod 46*a* (FIG. 5).

The cup spring 45 serves to resiliently load the roller 19 causing the same to rest against the wheel 2 in the work position.

By operating the pneumatic motor 36 and the handwheel 40 the roller 19 can be arranged in a proper position relative to the casting wheel 2. Thus for example it is possible to limit with accuracy the casting zone of the molten metal at the nozzle 11.

The Figures also show outer cooling devices 47 for cooling the wheel 2 from outside as well as the paths or trajectories 48 of the obtained continuous ingots shown with dotted lines.

In particular the cooling devices 47 are mounted on the drum support 22 in such a manner so as to rotate therewith. Such cooling devices 47 which envelope the wheel 2 for a length extending along more than half of the circumference thereof, are grouped into two assemblies having the same amplitude and both movable to and fro in a radial direction in order to make the wheel 2 accessible for maintenance, checking and replacement operations etc.

More precisely each assembly of devices 47 including the nozzles 47*a* (FIG. 6) for cooling action on the tape 4 and the nozzles 47*b* for cooling action on the sides of the casting wheel 2, is supported by a pin 49 fixed overhanging on a plate 50 which in turn is slidably mounted to move to and fro in a radial direction on a drum support 22 and is connected to a piston rod of a fluid-operated cylinder 51 mounted on the same support. In this way by operating the two cylinders 51 relative to the two assemblies of devices 47, the same assemblies are caused to move towards or away from the casting wheel 2.

In order to rotate together with the devices 47 carried by the rotatable drum support 22, the nozzles 29 for cooling the wheel 2 from inside thereof, are movable around the axis of the wheel 2. To this end the inner duct 28 which supplies water to the nozzles 29 and supports the same through the radial pipes 29*a* and the manifold 29*b*, can be rotated about its axis after having unloosened the screws 28*a* securing a metal ring 28*b* to the frame.

Such metal ring has an inner shoulder against which a friction ring 28*c* rests. Adjacent to this ring is a further ring 28*d* rigid with the duct 28 through a key engagement therewith.

On the other side of the ring 28*d* a further friction ring 28*c* is provided which rests on a portion of the frame of the machine. In this manner the rings 28*c* and 28*d* from a clutch connection which upon tightening of the screws 28*a* secures the duct 28, while upon unloosing the same screws allows the duct 28 and thus the nozzles 29, rigid therewith, to rotate.

From the above the operation of the continuous casting apparatus according to the invention should be clear.

In order to vary the casting direction the support 22 is rotated about the axis of the casting wheel 2 and the pulley 5 is moved relative to the upright. It is also necessary to move accordingly the crucible 10 in such a manner so as to arrange the nozzle 11 in the proper position.

A number of operational steps of the apparatus according to the invention with different casting directions as indicated by the arrow A, are shown in FIGS. 7 to 10. Thus in FIG. 7 the arrangement for vertical casting is shown, and the apparatus is set as shown in FIGS. 1, 3, 4 and 5.

For a casting direction slightly offset from the vertical, the arrangement shown in dotted lines in FIG. 7 is chosen, according to which the pulley 5 is secured in a position on the right of the Figure by causing the structure 8 to move along the beam 7 and fixing the same thereto. The support 22 will be correspondingly moved by causing the same to rotate through a slight angle around the axis of the wheel 2 after the screws 28 have been removed. The latter are tightened once the desired position has been attained.

The rollers 19 and 20, the taking-off unit and the outer cooling device 47 are thus suitably positioned. The position of the crucible 10 has also to be corrected by operating the motors 14, 17 and 18. It is also necessary to rotate the manifold 29*b* and the relative nozzles 29 designed to effect cooling inside the wheel 2. This is done by manually rotating the duct 28 after the screws 28*a* (FIG. 6) have been unloosened. When the desired

position is attained for the outer cooling devices **47** such screws are tightened again.

In order to attain the arrangement shown in FIG. **8** with a casting direction even more inclined relative to the vertical, movements similar to those described above have to be effected so as to arrange the rollers **19** and **20** in a suitable position, while the pulley **5** is further moved to the right along the beam **7**.

If a more inclined casting direction is desired, it is advantageous to move the beam **7** to the position shown in FIGS. **2** and **9** (this is done by removing the screws **9***a* and by screwing them up again after the desired position of the beam **7** on the upright **9** has been attained).

The apparatus can thus be arranged as shown in FIG. **9** (the arrangement shown in dotted lines corresponding to a further inclined casting direction.

To effect a metal casting in a horizontal or substantially horizontal direction the apparatus is set as indicated in FIG. **10**, by moving to the right and downwards the pulley **5** along the beam **7** and correspondingly rotating the support **22** about the axis of the wheel **2**. The crucible **10** is moved so as to arrange the nozzle **11** substantially as shown in FIG. **2**, or as mentioned above, the inner cooling unit carrying the nozzles **29** will be moved so as to be arranged at the outer cooling unit **47**, which is rotated together with the support **22**. Of course the length of the tape **4** must be changed when passing from one arrangement to another.

To move the rollers **19** and **20** away from the casting wheel **2** in order to allow the tape or the wheel to be replaced or for other reasons, the fluid-operated motor or power means **36** and the fluid-operated cylinder **33** are put into operation and act on the slide **35** carrying the roller **19** and on the arm **31** carrying the roller **20**. The movement of the taking-off device and the crucible **10** can be easily effected by operating the relative control means.

As stated above, also the two assemblies of the outer cooling unit **47** can be moved radially in an outward manner by actuating the fluid-operated cylinders **51**, thus making the wheel **2** accessible.

As can be noted, the provision of the rotary support **22** carrying the rollers **19** and **20**, the taking-off unit **21** and the outer cooling unit **47** allows the apparatus to be set according to various arrangements in a rapid and simple manner depending upon the desired casting direction.

The invention thus conceived is susceptible to numerous modifications and changes.

Thus for example the crucible **10** can be connected through suitably linked connections to the rotary support **22**.

Furthermore the pulley **5** can be moved by making use of a sliding system.

The device **39** can be controlled by a fluid-operated motor or cylinder. In practice the materials used as well as dimensions could be any according to the requirements and equivalent means can be provided.

I claim:

1. A continuous casting apparatus for producing continuous metal ingots or rods, comprising a supporting frame, a casting wheel assembly arranged for rotation on said frame and transmissively connected to relative power means and including a casting wheel,a continuous tape wound on the said casting wheel and around idle rollers, said casting wheel having a peripheral mold-like groove closed along an arc thereof by said continuous tape, and cooling devices for cooling the casting wheel assembly, the said apparatus further comprising a support unit co-axially mounted for rotation about said casting wheel and capable of being secured to said supporting frame at a number of angular positions, two idle rollers for the said tape carried by the said support unit at the periphery of said casting wheel, a taking-off or extraction means for withdrawing the produced ingot mounted on the said support unit, an idle pulley for the said tape which may be set in a plurality of positions relative to the said angular positions of the said support unit and is mounted on a support member rigid with said supporting frame, and a crucible which can be mounted in a number of positions at the periphery of the said casting wheel.

2. An apparatus as claimed in claim **1**, wherein said cooling devices include outer cooling devices for cooling said casting wheel assembly and mounted on the said support unit and rotating therewith .

3. An apparatus as claimed in claim **1**, wherein the said idle rollers are mounted on the said support unit with the interpositioning of a relative actuation device to move said rollers towards and away from the said casting wheel.

4. An apparatus as claimed in claim **3**, wherein the actuation device for moving one of said idle rollers towards and away from said casting wheel comprises a slide member sliding along guides arranged on said support unit, control means such as a fluid-operated motor for actuating said slide member, actuation means connected to the said slide member and provided with a pin alternatingly moving to and fro in a radial direction with respect to said casting wheel and an arm pivoted on the said slide member and articulated to said pin and carrying the relative idle roller.

5. An apparatus as claimed in claim **1**, wherein the said taking-off unit comprises power means for moving the said taking-off unit relative to said casting wheel.

6. An apparatus as claimed in claim **1**, wherein the said cooling devices include outer cooling devices movably mounted relative to the said wheel and arranged in two cooling assemblies movable to and fro in a radial direction on the said support unit, the said cooling assemblies being connected to relative control means preferably of a fluid-operated type.

7. An apparatus as claimed in claim **6**, wherein the support unit comprises a substantially drum-shaped structure centrally provided with a flanged sleeve mounted for rotation on a fixed sleeve and securable to the latter by means of screws and the like.

8. An apparatus as claimed in claim **1**, including a supporting member arranged on said supporting frame for sliding movement in a substantially horizontal direction, said crucible being mounted for sliding movement in a substantially vertical direction along said support power means being provided for displacing the said supporting member and said crucible to position the said crucible relative to the said casting wheel.

9. An apparatus as claimed in claim **8**, wherein the said supporting member is mounted for sliding move-

ment along two horizontal directions at right angles to one another parallel and normal, respectively, to the axis of the said casting wheel, power control means being provided to move the said support in said directions.

10. An apparatus as claimed in claim 1, wherein the said pulley is supported by a structure movably mounted on an overhanging beam which in turn is movably mounted on a fixed upright.

11. An apparatus as claimed in claim 1, wherein said cooling devices include inner cooling devices connected to securing means capable of allowing in the unsecured condition thereof the said inner cooling devices to rotate about the axis of said casting wheel.

* * * * *