ABSTRACT: A pinch roll assembly for use in a continuous-casting machine, which assembly can be shifted laterally from the machine to facilitate maintenance. The rolls at one side of the casting (usually journaled on fixed axes) are yieldable and positioned by springs to assure that they are aligned with the guide rolls above and bending rolls below. Assembly also includes side guides which engage starter bar as it passes through the pinch rolls, but retract while the slab is passing.
PINCH ROLL ASSEMBLY FOR A CONTINUOUS-CASTING MACHINE

SPECIFICATION

This invention relates to an improved pinch-roll assembly for a continuous-casting machine.

The form of continuous-casting machine in which my pinch-roll assembly is used includes a water-cooled mold open at both ends, trams of vertically spaced guide rolls below the mold, 24 pair of power-driven pinch rolls below the guide rolls, and a curved casting guide below the pinch rolls. Before a casting operation begins, a starter bar is inserted upwardly through the pinch rolls and guide rolls to the mold. A stream of molten metal is poured through the mold into contact with the top of the starter bar, which descends through the guide rolls and pinch rolls ahead of the resulting slab. As the slab passes the guide rolls, water sprays are applied to its surface to aid in solidifying it. Initially the leading end of the slab attaches itself to the top of the starter bar, but the starter bar is disconnected as the slab reaches the pinch rolls. At first the pinch rolls restrain or restrict the starter bar, but after the slab is part way through the guide rolls, the pinch rolls propel the starter bar and slab. After the starter bar is disconnected, bending rolls within the casting guide bend the slab 90° so that it travels horizontally from there on for further processing. Reference can be made to Foldssey U.S. Pat. No. 3,338,297 for a more complete showing of such a machine, although my invention is not limited to use in this particular machine.

An object of my invention is to provide an improved pinch roll assembly in which the rollers are jounced on fixed axes now are yieldable, being jounced on axes having limited movement, and are spring urged toward the other pinch rolls.

A further object is to provide an improved pinch roll assembly which has side guides for engaging the starter bar as it passes between the pinch rolls, the side guides being hydraulically retractable for clearing the slab after the starter bar has passed.

A further object is to provide an improved pinch roll assembly equipped with load cells and adjustable thrusters for controlling pressures on a slab.

In the drawings:

FIG. 1 is a top plan view of my improved pinch roll assembly;
FIG. 2 is a side elevational view of the assembly;
FIG. 3 is a vertical longitudinal section on line III--III of FIG. 1;
FIG. 4 is a vertical cross section on line IV--IV of FIG. 1 omitting the mechanism for propelling the assembly laterally;
FIG. 5 is a horizontal section on a larger scale on line V--V of FIG. 2;
Fig. 6 is a top plan view on a still larger scale of one of the pinch roll cluster subassemblies;
FIG. 7 is a front elevational view of the subassembly shown in FIG. 6; and
FIG. 8 is a vertical section on a larger scale on line VIII--VIII of FIG. 2.

FRAME

My pinch-roll assembly includes a welded steel frame formed of spaced-apart side members 10 and 10a, a spreader bar 12 connecting the side members inwardly from each end at both top and bottom, and trusses 13 connecting the top and bottom spreader bars. The frame is mounted on trucks 14 located underneath each end. The trucks include flanged wheels 15 and 15a which ride on transverse rails 16 mounted on beams 19, whereby I can shift the entire assembly sideways. As FIG. 2 shows, between the pinch rolls are carried piston rods 21 which have upwardly extending reciprocable piston rods 22. The upper ends of the piston rods carry tapered pins 23 which fit within keepers 24 on the side members 10 and 10a to hold the assembly in proper transverse alignment with the guide roll trains above and the bending rolls below (not shown). I lock the pins in the keepers with wedges 25 inserted through slots in the pins and thus hold the assembly against or prevent the slab as the pinch rolls propel the slab. As FIGS. 1 and 5 show, the outer face of the side member 10a carries a pair of brackets 28 and 28a on which I mount respective speed reducers 29 and 29a connected by a line shaft 30. I support a motor 31 on bracket 28 to drive the two speed reducers. The output shafts of the speed reducers carry pinions 32 which mesh with gears 33 fixed to wheels 15a. To shift the assembly for maintenance, I remove wedges 25 and operate cylinders 21 to withdraw pins 23 from their keepers 24. Thereafter I operate motor 31, which turns pinions 32 and gears 33 and thus propels the assembly along rails 16.

PINCH-ROLL CLUSTERS

As FIGS. 2 and 3 show, the assembly includes four subassemblies 36, 37, 38 and 39 of pinch-roll clusters, all of like construction which I can install or remove as units. I mount the subassemblies 36 and 37 in the frame one above the other to the left of the pass line of a slab 5, and the subassemblies 38 and 39 to the right of the pass line. FIGS. 6 and 7 show the construction of one subassembly in detail. The subassembly includes a backplate 40 on which I mount brackets 41 near each end and bearings 42 intermediate its length. Each bracket 41 carries a series of bearing cocks 43 (three illustrated) aligned with those on the other bracket. I journal pinch rolls 44 in the bearing cocks. Each roll 44 has a splined end portion 45 outside the bearing cock for connection to a suitable power drive (not shown). The surface of each roll has right and left-hand helical grooves 46 extending from the ends to the middle. Backup rolls 47 are journaled in bearings 42 and contact the pinch rolls.

I affix the backing plates 40 of the subassemblies 36, 37, 38 and 39 to follower plates 50, 51, 52 and 53 respectively. Each backing plate carries a series of pins 54 which extend away from the pinch rolls and are respectively received in keepers 55 fixed to each end of the followers (FIG. 2). I lock the pins in place with wedges 56 inserted through the slots. The side members 10 and 10a have aligned windows 57 in their central portions. At the upper and lower edges of these windows, the side members carry horizontal guide bars 58 and 59 for the four subassemblies and their followers. As hereinafter explained, the two subassemblies 36 and 37 at the left are normal function, but are yieldable, while the two subassemblies 38 and 39 at the right are shiftable toward and away from those at the left.

MOUNTING OF STATIONARY CLUSTERS

As FIGS. 2, 3 and 5 show, the two side members 10 and 10a carry vertical bars 61 fixed to the left edges of their windows 57. A housing 62 is fixed to bars 61 and to the horizontal guide bars 58 and 59 in line with the left portion of windows 57. The housing contains a transverse vertical plate 63 fixed between its side walls intermediate its length (FIGS. 3 and 5). The back face of plate 63 carries a plurality of sleeves 64 welded thereto. The back faces of the followers 50 and 51 carry bolts 65 slidably received in sleeves 64. Compression springs 66, preferably of the "Belleville" type, encase the outer end of each bar against the followers 50 and 51 at one side and against plate 63 at the other side. The springs urge the left pinch rolls toward the right. As long as no slab or starter bar is within the assembly, the circumferences of the left pinch rolls project slightly beyond the circumferences of guide rolls embodied in the assembly as hereinafter described. When a starter bar or slab is introduced, the springs yield to move the rolls to move into vertical alignment with the guide rolls.

MOUNTING OF SHIFTABLE CLUSTERS

A carriage 69 is slidably mounted within the guides 58 and 59 to the right of the followers 52 and 53. A plurality of bolts...
70 span the space between the followers and carriage (FIG. 3). Nested compression springs 71 encircle bolts 70 and urge the followers and subassemblies 38 and 39 toward the left for applying pressure against the slab. I can adjust the compressive force of the springs by adjusting nuts 72 on the bolts 70 for small adjustments, or by adding or removing springs for larger adjustments. As FIGS. 2 and 8 show, the side members 10 and 10a carry outwardly projecting vertical yokes 73. The yokes span the windows 57 opposite the carriage 69, and carry inwardly extending rollers 74. I affix slotted guide plates 75 to the sides of the carriage 69. The slots receive the rollers 74 to control the mutual movement of the carriage.

Truck 14 at the right carries outwardly projecting brackets 78 connected at their ends by a transverse beam 79 to form a cantilever support (FIGS. 2 and 3). I mount a pair of mechanical screw-type thrusters 80 and a drive 81 for the thrusters on this support (FIG. 1). The right ends of the side members 10 and 10a carry transverse annular plates 82 to which I bolt the ends of the thrusters. The thrusters per se are known devices available commercially. One example of a suitable thruster is the "Roll-Ramp" linear actuator of the Philadelphia Gear Corporation, King of Prussia, Pa. Hence I have not shown the thrusters in detail. The side frame members 10 and 10a have annular bearing sleeves 83 fixed thereto. The thrusters have output shafts 84 which extend through sleeves 83 and are attached to carriage 69 through conventional load cells 85.

GUIDE ROLLS

As FIGS. 1 and 3 show, the assembly also includes guide roll subassemblies 88 and 89 removably mounted between the side members 10 and 10a above and below the pinch roll clusters respectively. These guide roll assemblies define a pass which is aligned with trains of guide rolls above and beneath the rolls below as shown in the aforementioned Foldessy patent. The guide roll subassembly 88 has removable frame members 90 in which I journal three idler rolls 91 at the left of the pass line and three similar rolls 92 at the right of the pass line. The subassembly also includes backup rolls 93 for the guide rolls. The subassembly 89 is of similar construction.

SIDE GUIDES

As FIG. 4 shows, the assembly includes two upper side guides 96 and two lower side guides 97, all of like construction. Each side guide has a bracket 98 mounted on the side member 10 or 10a above or below the pinch-roll clusters in line with the pass. The bracket carries a fluid pressure cylinder 99 which has a reciprocable piston and piston rod 100. The end of the piston rod projects through the frame 88 of the guide roll subassembly and carries an idler roller 101. I operate the cylinders 99 to extend the piston rods 100 and rollers 101 into engagement with the edges of the starter bar while it is passing through the assembly. Thereafter I operate the cylinders to retract the piston rods and rollers while the slab is passing.

OPERATION

In operation, I adjust the thrusters 80 so that the pinch rolls 44 of the subassemblies 38 and 39 bear against the slab 5 with a predetermined pressure indicated on suitable instruments connected with the load cells 85. The position of course varies for slabs of different width. The pinch rolls 44 of the other subassemblies 36 and 37 yield as pressure is applied to the slab and automatically move into vertical alignment with the idler guide rolls 88. The grooved faces of the power-driven pinch rolls firmly grip the slab, first to restrain it and subsequently to propel it into the bending rolls below. Preferably I measure the slab temperature continuously with radiomatic tubes as the slab enters the pinch-roll assembly, and I control the volume of water sprayed on the slab in accordance with this measurement. This maintains the slab at a constant temperature.

While I have shown and described only a single embodiment of my invention, it is apparent that modifications may arise.

Therefore, I do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

I claim:

1. A pinch-roll assembly comprising:
   a steel frame formed of side members and spreader bars connecting said side members;
   clusters of opposed power-driven pinch rolls formed as subassemblies supported in said frame defining a vertical pass line therebetween for a continuously cast slab;
   the subassemblies on one side of said pass line being normally stationary but yieldable under pressure;

   spring means urging said yieldable subassemblies into space normally occupied by slabs as they pass through the assembly;
   the subassemblies on the other side of said pass line being shiftable toward and away from said yieldable subassemblies;
   each of said subassemblies including a backing plate, a plurality of pairs of aligned bearing chocks supported on said backing plate, a plurality of bearings mounted on said backing plate intermediate said chocks, respective pinch rolls journaled in each of said pairs of chocks, and backup rolls journaled in said bearings and engaging pinch roll, said pinch rolls having splined end portions extending outside said chock for connection to a power drive, said pinch rolls having right and left-hand helical grooves extending from the ends to the middle;

   thrusters supported on said frame and operatively connected with said shiftable subassemblies;
   spring means between said thrusters and said shiftable subassemblies;
   and load cells between said thrusters and said shiftable subassemblies for measuring the pressure on a slab as it passes between said pinch rolls.

2. An assembly as defined in claim 1 further comprising trucks underneath each end of said frame supporting said frame, said trucks having flanged wheels, and rails on which said wheels ride, whereby the assembly can be shifted sideways to facilitate maintenance.

3. An assembly as defined in claim 2 further comprising a drive mounted on said frame and operatively connected with said wheels for propelling the assembly along said rails.

4. An assembly as defined in claim 1 further comprising retractable side guides mounted in said frame at both sides above and below said subassemblies.

5. An assembly as defined in claim 4 in which each of said side guides includes a fluid pressure cylinder fixed to said frame, a piston rod extending from said cylinder toward said pass line, and a roller journaled to the end of said piston rod.

6. An assembly as defined in claim 1 in which there are two thrusters mounted on one end of said frame having output shafts, said frame having guide sleeves slidably receiving said output shafts.

7. An assembly as defined in claim 1 further comprising followers on which said subassemblies are removably mounted, a housing in said frame behind said yieldable subassemblies, said first-named spring means being mounted in said housing and engaging the followers for said yieldable subassemblies, and a carriage mounted in said frame behind said shiftable subassemblies, said second-named spring means being mounted between said carriage and the followers for said shiftable subassemblies, said thrusters being connected to said carriage.

8. An assembly as defined in claim 7 further comprising yokes mounted on the sides of said frame, rollers journaled to the insides of said yokes, and slotted guides on said carriage riding on said rollers.

9. A pinch-roll assembly comprising:
   a steel frame formed of side members and spreader bars connecting said side members;
   clusters of opposed power-driven pinch rolls formed as subassemblies supported in said frame defining a vertical pass line therebetween for a continuously cast slab;

   the subassemblies on one side of said pass line being normally stationary but yieldable under pressure;
spring means urging said yieldable subassemblies into the space normally occupied by slabs as they pass through the assembly;
the subassemblies on the other side of said pass line being shiftable toward and away from said yieldable subassemblies;
thrusters supported on said frame and operatively connected with said shiftable subassemblies;

spring means between said thrusters and said shiftable subassemblies;
load cells between said thrusters and said shiftable subassemblies for measuring the pressure on a slab as it passes between said pinch rolls; and
subassemblies of idler guide rolls supported in said frame above and below said first-named subassemblies.